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FLEETSIDE PICKUP

Trim-lined Fleetsides come with 6½- or 8-ft bodies, and include such features as front and rear coil-spring suspensions, self-adjusting brakes and big 3-man cab. Larger body on tough ¾-ton chassis is the most popular camper choice. Four-wheel-drive is available for these models.

STEPSIDE PICKUP

Here are economical pickup models offered in the same range of body sizes and with the same features as the Fleetsides above. In addition, there's a big Stepside pickup with 9-ft. body on a tough 1-ton chassis — just the ticket for those who need extra room and ruggedness.

CARRYALL

Seats six with lots of luggage space in rear. Also available with seating for eight. Large double rear doors are offered in two styles — side opening or popular tailgate-liftgate type. Work-proved coil-spring suspensions, front and rear, smooth the miles away to let you arrive fresh and ready to go.

EL CAMINO

Here's the beauty queen of the Chevy line. Its versatility and good looks make it equally at home at a campsite or in a suburban driveway. Roomy 6½-ft. pickup box can carry over a half-ton of camping gear, or be fitted with special camper bodies such as the one illustrated at right.

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Or, perhaps you like the new "traveling home" idea — roomy vans all fitted out with modern comforts and conveniences. You can choose a basic Chevy-Van body for custom fitting, or the big Step-Van fully equipped and ready to go. Either way gives luxurious traveling.

For carrying lots of people and equipment, and hauling a trailer, too, look at the versatile Carryall. You'll like its roominess and easy handling.

Pick a Chevy and you'll travel with comfort and confidence. Chevy chassis have proved their toughness and reliability in all kinds of demanding truck work. And you get a smooth ride that adds an extra dimension to your vacation pleasure.

With this big choice, and the Chevy reputation to back it up, you'll want to see your Chevrolet dealer soon. He'll be happy to give you a special camper brochure — or you can get one by writing to Chevrolet Division of General Motors, Detroit, Michigan 48202.

CHEVROLET

THE LONG STRONG LINE

STEP-VAN — This one's all new from Chevrolet. It gives mobile living at its luxurious best. Full stand-up head room, sleeping for four plus cooking and sanitary facilities. And you'll be pleasantly surprised at its low, low cost!

CHEVY-VAN—The roomy Chevy-Van is readily converted to provide handy cooking and sleeping facilities. Its 211-cu. ft. volume allows a variety of arrangements to suit individual preferences. Your Chevrolet dealer can give you full information about having such conversions done for you.

CHASSIS-CAB—Rugged Chevrolet chassis-cabs are offered in a range of wheelbases to fit many different sizes and styles of camper bodies. Big 3-man cab gives plenty of stretch-out room for comfortable traveling. Four-wheel-drive available for ½- and ¾-ton models.

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Vol. 186 No. 5

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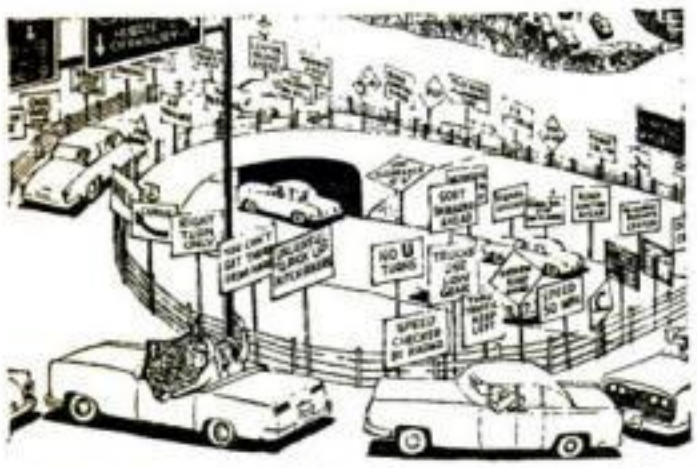
Cover painting by Sigman-Ward
May 1965

It's Ford vs. Offy in the '65 Indy—and watch the records snap! Page 78.



Are they finally doing something about killer road signs? Page 104.

Throw your motor overboard? You might, to save your life. Page 114.

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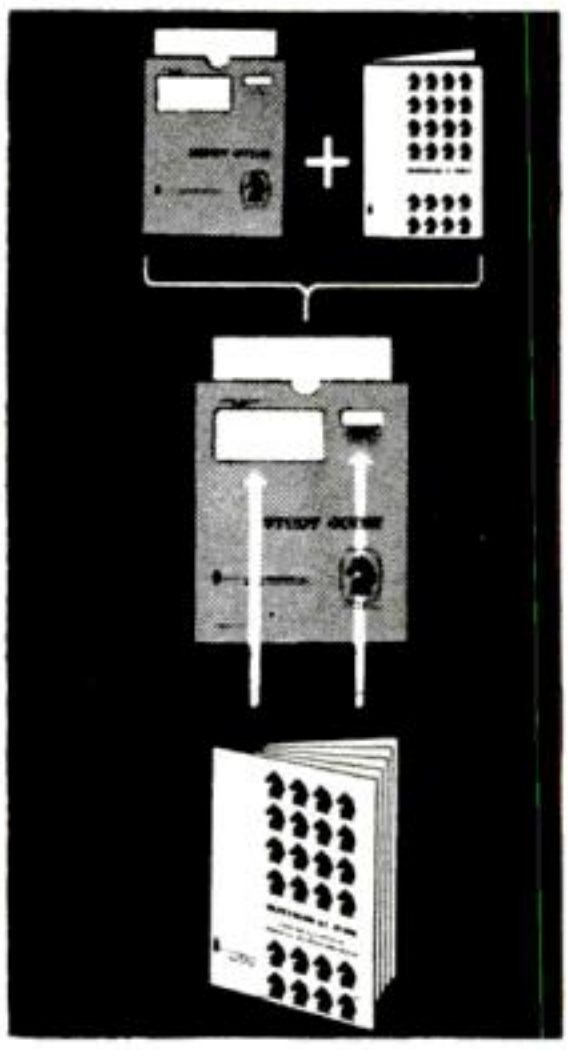

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PS readers talk back

Want to get something off your chest? Write "Readers Talk Back," Popular Science, 355 Lexington Ave., New York, N.Y. 10017.

Semi-Congratulations

Mr. Mann ["Are You In More Danger in a Small Car?" Feb.] made an excellent report. Although he felt that the answer was "yes," he gave both sides of the story. And although he *based* his article on ACIR's report, he used other sources while reporting the facts.

Mr. Francis, on the other hand, starts off by telling us that his family owns and loves small

cars, and quotes a story involving typhoid and statistics. Finally he "settles down to his work" (?) and gives us a chart based on "simple arithmetic," which excludes people injured when thrown from cars "on the reasonable premise that your hurts are the same whether you are thrown from a Cadillac or a Volkswagen"—a hardly reasonable premise. Since these cars aren't built the same, your hurts would be different. He attacks statistics in general, and Cornell, and admits, "At this point, they've lost me." Why attack what is beyond his meager intelligence? His attacks are based only on Renault's comments (surely prejudiced) and his son's (unexposed to all car makes, how can he compare all car makes?).

I like and prefer small cars, but Francis' report didn't deal with the question.

DAVID SAUNDERS, Newton, Mass.

. . . Francis not only "distrusts statistics," he fails to understand that methods and theoretical considerations upon which statistics are based are objective and all statisticians applying them to a set of data would arrive at the same conclusions. Mr. Francis' approach indicates some degree of non-objectiveness.

He tells us the "absurd" story of typhoid victims among 100 people: "Statistically, there are 99 persons who are 99-percent healthy and 1-percent sick, and one person who is 99-percent sick and 1-percent healthy." No statistician worth hiring would make such a statement. If Mr. Francis wishes to demonstrate inconclusiveness of the Cornell study, let him objectively and scientifically exhibit the fallacies in the procedures and methods used in the study, or the errors (if any) made.

He does make some valid points. A certain positive degree of correlation exists between age of driver and accident occurrences, and he claims this was not taken into account when the raw data was adjusted. If young drivers do own a greater proportion of small cars than large cars, this should be taken into account. I strongly suspect, however, that it *was* considered in performing the analysis of variance required. Similarly, the speed potential of smaller cars is a factor to be considered.

PAUL S. KIRSCHENBAUM
Dept. of Mathematics
The City College of New York.

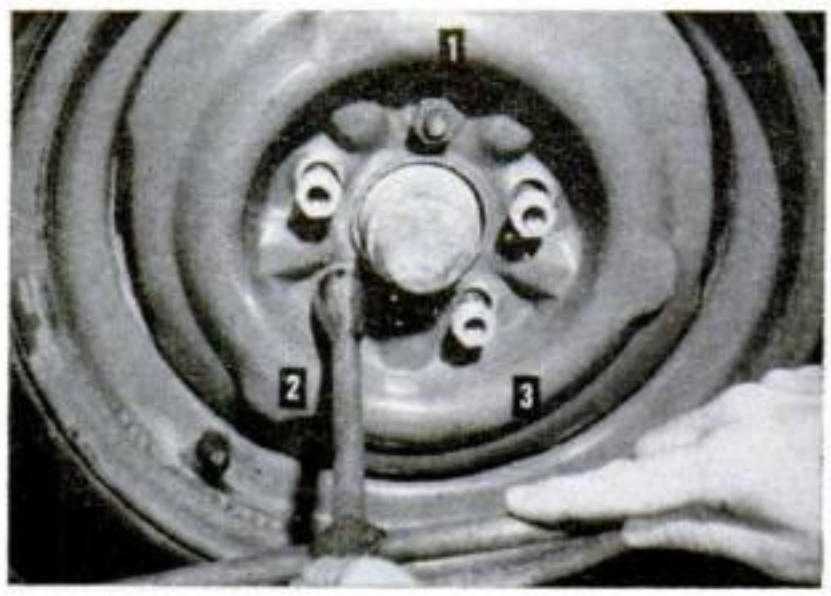
Tip for Shooters

The picture of a "home made," "no-cost" bullet stop ["Setting up a Basement Shooting Range," Mar.] showed a steel, spring-type clip holding the target. This could be a hazard—a bullet could glance off it. The solution: nonmetallic photographic gummed corners or contact tape.

JOHN SHERRARD, Allentown, N.J.

More on Balancing Car Wheels

For a number of years I have balanced my car's wheels as you describe ["Balance Your Car's Wheels," Dec. '64]. However, I do not understand the necessity for numbering the



lug holes [picture 10] and tightening the wheel in any particular sequence when mounting the rear wheel at front and remounting at rear.

J. R. SUBLETT, Albuquerque.

Author Day explains: "The reason is to locate the wheel as nearly as possible in the same position front and rear. Rims are not perfect. Whenever a rim is tightened, the first lug hole drawn tight has the most control over the wheel's position. This one gets precisely cen-

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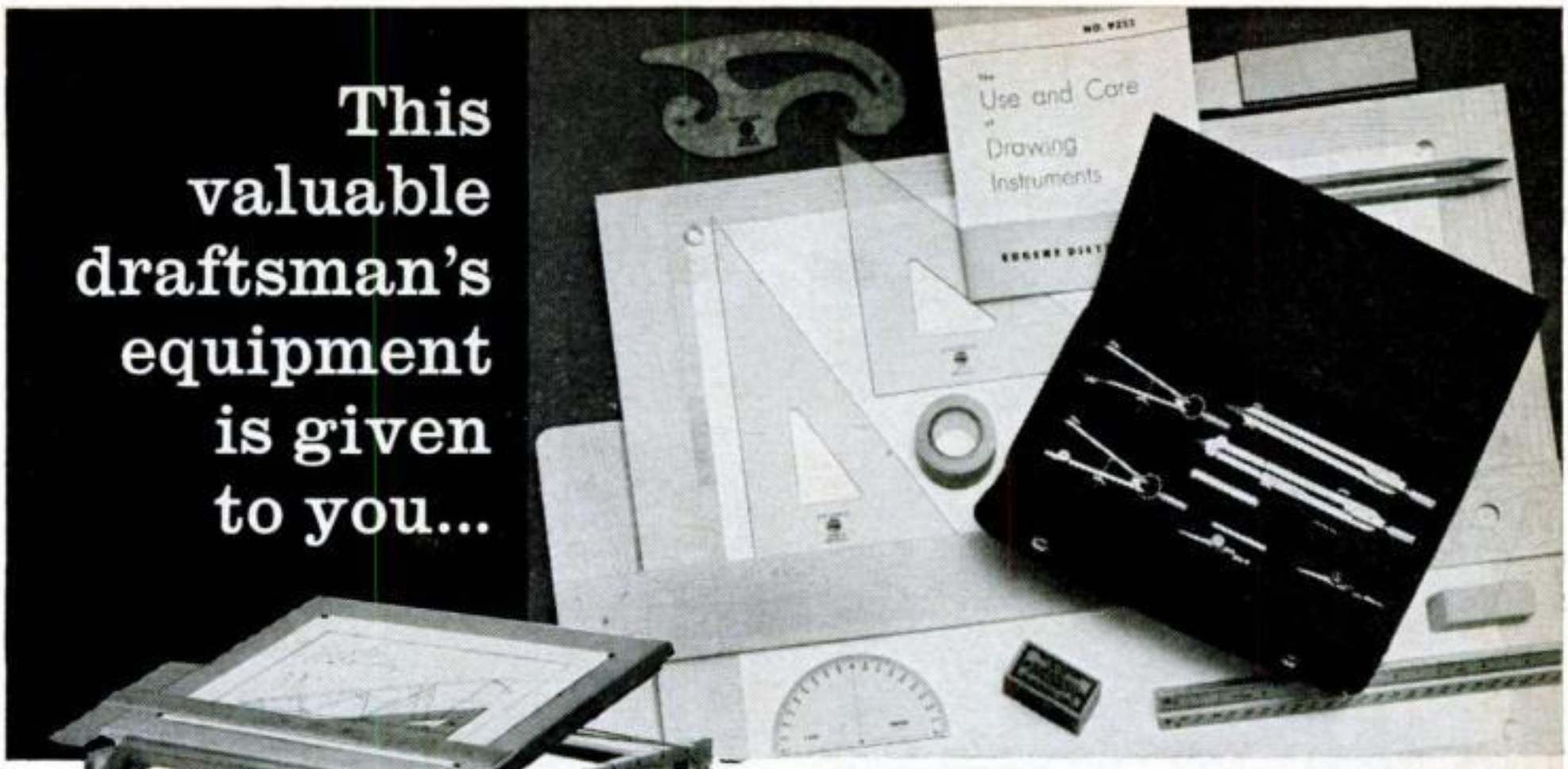

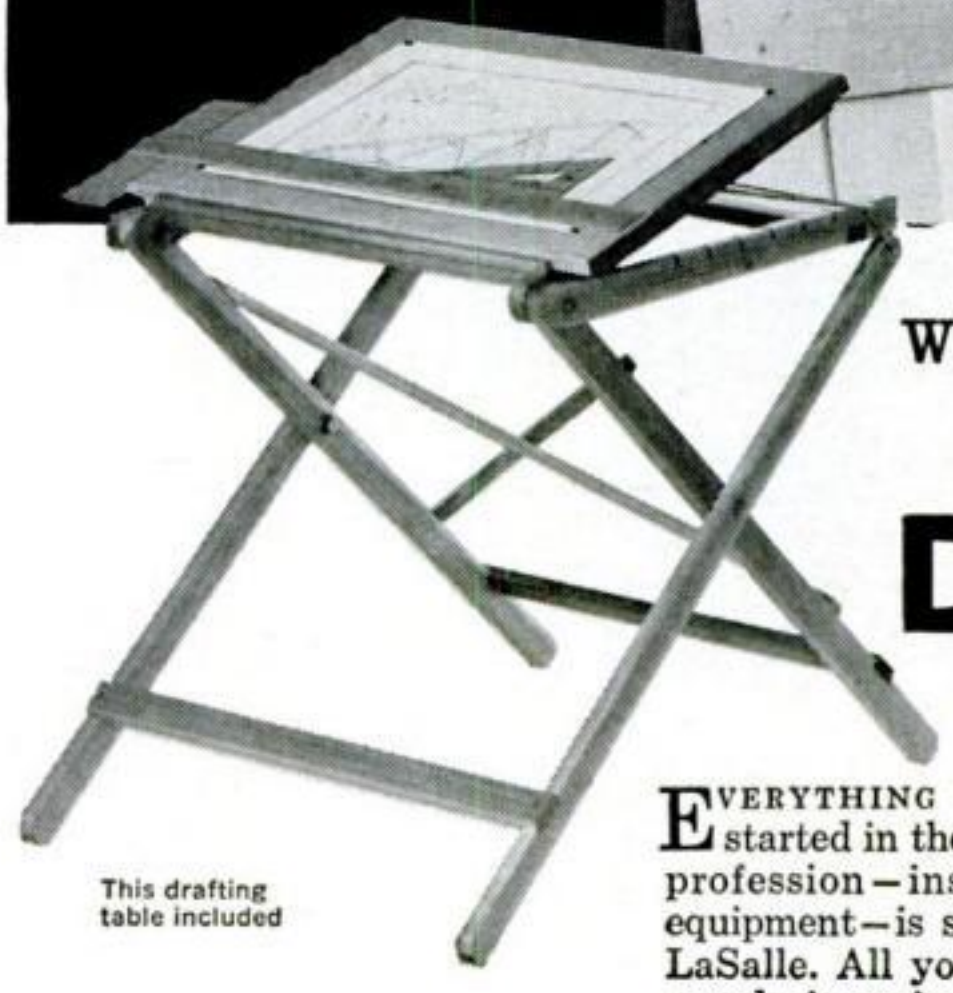

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tered about its stud. The second one drawn tight merely rotates the wheel on an arc about the first hole before becoming snug. The third lug merely reinforces the position taken by the first two. On a 30-pound wheel-tire assembly, a difference in wheel placement of only .01 inch can produce about five inch-ounces of unbalance."

Working for Uncle Sam

Obviously, Englebardt ["Careers for Specialists," Feb.] was aiming at those who intend to return to civilian status to apply valuable training received in the service. But he neglected to mention that men serving a first enlistment get no "special proficiency pay." My job carries a pro rating of $100 per month—the maximum. But I can't get any of it, and never will unless I re-enlist for three more years.

And that extra $51.30 pulled in by single men living off base: Single men rarely get to live off the post. When they do, policy is to put them in billets as fast as enough are built.

J. F. KELLY, APO N.Y.

. . . Somebody should tell Englebardt that E-5 status means "specialists" as well as noncoms. Because of their technical nature, most of the job openings he recommends are filled by grade E-5—and even E-6—specialists. A specialist is a man whose pay is supposedly commensurate with his technical ability, but who is not in a leadership capacity. He is *not* an NCO.

As a specialist 5, I receive roughly $230 monthly—no pro pay (not eligible), no food allowance or quarters pay. Although serving overseas, I (like tens of thousands) get no overseas pay. And is your author serious when he says "Once you make NCO status, E-5 or higher . . . you are freed of onerous chores?" I sweep floors, wax and mop them, too, and I know sergeants who still pull guard duty.

P. M. FERRARA, APO N.Y.

Skipping the Oil Change

In "50,000 Miles Without an Oil Change" [Mar.], you report one car's filter inoperative for some 10,000 miles with no harmful results. Since 1933, I have not changed the oil in any of our cars for the first 30,000 miles and, in some cases, for 55,000 miles. A '59 Buick we drove had over 60,000 miles on it with oil added only after the break-in oil was drained

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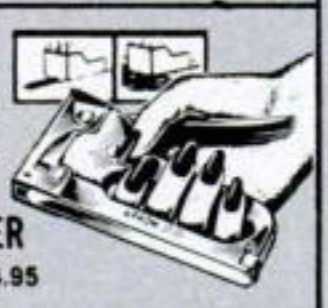

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Completely New Training-at-Home

for the man who wants to SAVE MONEY and MAKE MONEY
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NRI's 50th Anniversary Brings You This Opportunity of a Lifetime To Become a Master Appliance Technician . . . Save on YOUR OWN Home, Shop or Farm Repairs . . . Make $3 to $5 an Hour Fixing and Servicing Appliances for Your Neighbors!

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NRI's special new section on modern air conditioning and refrigeration gives you complete know-how in this fast-growing field. Other sections are invaluable for men who work on farms, or in stores or plants. No matter what you're called on to fix, in no time you'll be making repairs like a pro. And – you now get special bonus lessons on 2- and 4-cycle gasoline engines!

Make Extra Money

More than a MILLION appliances and engine-powered tools are sold *each week!* Once you can fix them, you'll "cash in" on this boom. It's a fact: NRI-trained men earn $3.00 to $5.00 an hour *in spare time alone!*

Don't worry how little you may *now* know about repair work. Former student John D. Pettis, who works out of his basement, says: "I had practically no knowledge of any kind of repair work. Now I am busy almost all my spare time and my day off – and have more and more repair work coming in all along."

No matter where you live, everyone owns and *depends on* appliances. And once you know how to service them, the owners depend on YOU!

MAIL COUPON TODAY

Wouldn't you like *right now* to be able to repair your own broken appliances? Wouldn't you like *right now* to have money coming in each week? Let NRI show you how. Free Book and Free Sample Lesson describe the new, expanded, low-cost NRI Course in full . . . show how you can quickly master repairing appliances in your spare time. Mail coupon TODAY (or write direct to): *National Radio Institute, Dept.601-055, Washington, D.C. 20016.* (No obligation, of course – and no salesman will call on you.)

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at 5,000 miles. There has been no sign of engine damage in any of our cars.

I know sludge forms, but so far I've seen only one sign of it—it plugged the oil-pressure line on our '49 Buick at about 54,000 miles. We have never had bearing trouble.

E. C. Eddy, Fairview, Mich.

. . . One: A police car whose motor is left running many hours each day presents entirely different oil-contamination problems than a car used for short trips to and from the grocery store. Two: A lubrication system that worked well in balmy Florida might be totally inadequate during a northern winter. Three: We have no assurance that sludge, which apparently caused no trouble during 49,949 test miles, would not have plugged a vital oil passage at 49,950 miles.

Robert D. Gillette, M.D., Huron, Ohio.

. . . Although Detroit might use the "new" centrifugal oil filter on cars next year, the Simca 1000 has it now. It uses the same principle as your Bergstrom test models, but is built into the engine rather than onto it, possibly making it a little more difficult to clean. The one on my new Simca works beautifully.

Frank Claus, Cecil Field, Fla.

Helping Hand for Shower Fans

While we do not make a ceramic shampoo holder to match other bathroom built-in fixtures ["I'd Like to See Them Make," Mar.], we can help out Mr. Robert Ham. Our squeeze bottle of liquid shampoo can be up-ended in a stick-on wall holder sold with it. The bottle has a unique pull-out spout to dispense just the right amount of shampoo.

Paul H. Voorhees
Pen-Con, Inc., Phoenix, Ariz.

Ready for a Big Move?

The dangers of climate changing ["The Weather—What We *Can* Do About It." Mar.] cannot be overemphasized. Once a change is initiated, it cannot be revoked. The four ideas suggested could act adversely.

1) Warm the polar icecaps—and melting ice could raise the sea level and flood lands now at sea level.

2) Evaporation-proof the oceans—and the water cycle would be drastically altered. Floods might be averted, while deserts appeared in marginal-rainfall areas. Our freshwater supply would become more limited.

3) Blanket the Arctic in a vast cloud—and the heat melting the ice would then bring floods.

New from Rockwell, the world's

Let the Porter-Cable Green Line make your yard work easier!

Don't be fooled by their good looks, these tools are tough. Each one is:
SHOCKPROOF—constructed of non-conductive miracle material, double insulated against electrical shock from product malfunction.
BREAKPROOF—housing is absolutely guaranteed against breakage.
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Clip this coupon. Send for FREE folder and name of nearest dealer.

Edger-Trimmer. Special introductory price —$36.88. Head turns to 45° and 90° for trenching and edging.

Grass Shear. Special introductory price—$26.88. Also trims and shapes shrubs, hedges, etc.
Available with extension handle and wheels.

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Please send more information on these new tools to:

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4) Inject rocket-borne materials into the upper atmosphere—and insulating or magnifying the energy reaching earth could cause changes in the average temperature of a magnitude of 50 degrees F. A new Van Allen-type belt might be created, adding new hazards to space travel.

Weather can be changed, but nobody dares do anything about the *climate*, except move.

RICHARD H. MOORE, Wooster, Ohio.

Building a Humidifier

I constructed the water-spray humidifier [Jan.] and it is working very efficiently, keeping about 20,000 cubes at 35-percent humidity. But finding the solenoid mixing valve isn't easy; also the ⅜" fitting to couple the oil-burning nozzle adapter to the mixing valve. I discovered that the adapter actually was tapped for what is known as a ¼" fitting, although it did measure ⅜" inside. I got the nozzle adapter from an oil-burner maintenance man. Hardware and plumbing suppliers don't have 'em.

I had trouble, too, getting a proper spray with the oil-burning nozzle. Then I found that slight counterboring with a fine drill from outside at the orifice did the trick.

CHARLES W. FLINT, Xenia, Ohio.

. . . Water-spray humidifiers often produce a "mineral fallout," especially where water is very hard. Then a white dust covers everything in the house. It occurs because evaporation of the water sprayed into the duct occurs in the air. The minerals left behind are blown through the ducts in the form of a dust. Some commercial humidifiers incorporate an evaporator mat, usually a very porous material, kept moist at all times. The air from the plenum is blown over the mat, where evaporation occurs. Since the water itself is not blown into the duct, the residue minerals are trapped on the mat.

GUS J. VLAHAKES, Union, N.J.

Through the Kindness of Friends?

I'd like to know the source of Mr. Galton's statistics ["Questions About Blood," Mar.] in his statement, "Hepatitis has been transmitted by approximately one in every 150 to 200 transfusions." These figures do not apply to blood distributed by the American Red Cross. The very fact that the Red Cross does not buy blood acts as a safeguard for blood recipients. Donors are not motivated by monetary gain.

It was gratifying to read an article on blood which, for once, did not promote fear and distrust simply to attract readership.

E. PLACE, Yakima, Wash.

Many patients receive blood directly from relatives, neighbors, or co-workers, or use such blood to replace a quantity previously drawn from a hospital's bank.

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The new tools are Rockwell-built . . . safer for you

Hedge Trimmer. Special introductory price —$26.88. Standard equipment includes exclusive pruning saw attachment and side handle.

13

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'Say, Smokey–'

A clinic on cars by America's most famous mechanic

EACH month in POPULAR SCIENCE, Smokey Yunick will answer questions on cars–family cars, high-performance jobs, hot rods, and racing cars–selected from those sent in by readers. Got a problem? Ask Smokey. You'll find the address at the end of the column. Please *print* your name and address.

►***"I've had more than my share of trouble with the automatic choke on my '56 Mercury with about 50,000 miles. Can you suggest something?"—Harry Puterbaugh, Leucadia, Calif.***

Normally, an auto-choke works well. But if yours is so bad, the cheapest, most reliable fix would be to install a manual choke, available at any parts dealer.

►***"My '64 Tempest 326 is a fine car, except—extremely rough idle, hard starting, and only 10 to12 m.p.g. The Pontiac garage has worked on it, even rebuilt the carb, but to no avail. It does have air conditioning and automatic transmission, but shouldn't I expect more? I'm not a throttle stomper and have used every trick I know to get better mileage."—J. J. Greenhalg, Mineral Wells, Tex.***

This isn't normal performance from that car. Have the dealer check for proper compression. Then he should go through the valve system to make sure the camshaft is okay. Check for sticking valves and look for gasket leaks. If you have any Mickey Mouse gadgets for easier starts or better running, throw them away. They won't help. Have a complete tune-up to factory specs. Don't expect too much in the mileage department–not over 14 to 18 m.p.g. in this car with normal driving. These engines are fine performers when they are right, but will never be noted for fuel economy.

►***"My '58 Chevy wagon with small V-8 has pulled a 1,500-pound trailer about 58,000 miles through the mountains. Is there some way to test the automatic transmission for slippage, like putting it in low with the parking brake on, or something like that?" —Ralph Feath, Charleston, S.C.***

There's only one sure way to check for slippage, and that is while driving. When it shifts into high range, if any slippage is occurring it will feel slow or erratic. Or it might just feel like a slipping clutch on a straight-stick job.

►***"At speeds above 60 m.p.h., my '64 Rambler American fishtails on these South Texas roads—especially in windy weather. Any way to correct this?"—Herbert G. Richeck, San Antonio, Tex.***

Here's what you can do to gain lateral stability in a light car: Check the alignment of the whole car–front and rear. See to it that wheels are in track, and that no fastening points have come loose or shifted. Install heavy-duty shocks, and if there is a heavier sway-bar option, have it installed. Carry some weight in the trunk. A last resort would be to change over to the 1965 tire size–which has a lower profile and wider footprint–and run higher air pressures than recommended.

►***"My problem is brake fade when driving my 5,100-pound '58 Lincoln in the mountains. I use low gear as much as possible, but some of the places I get into require hard braking also. Sometimes the brakes***

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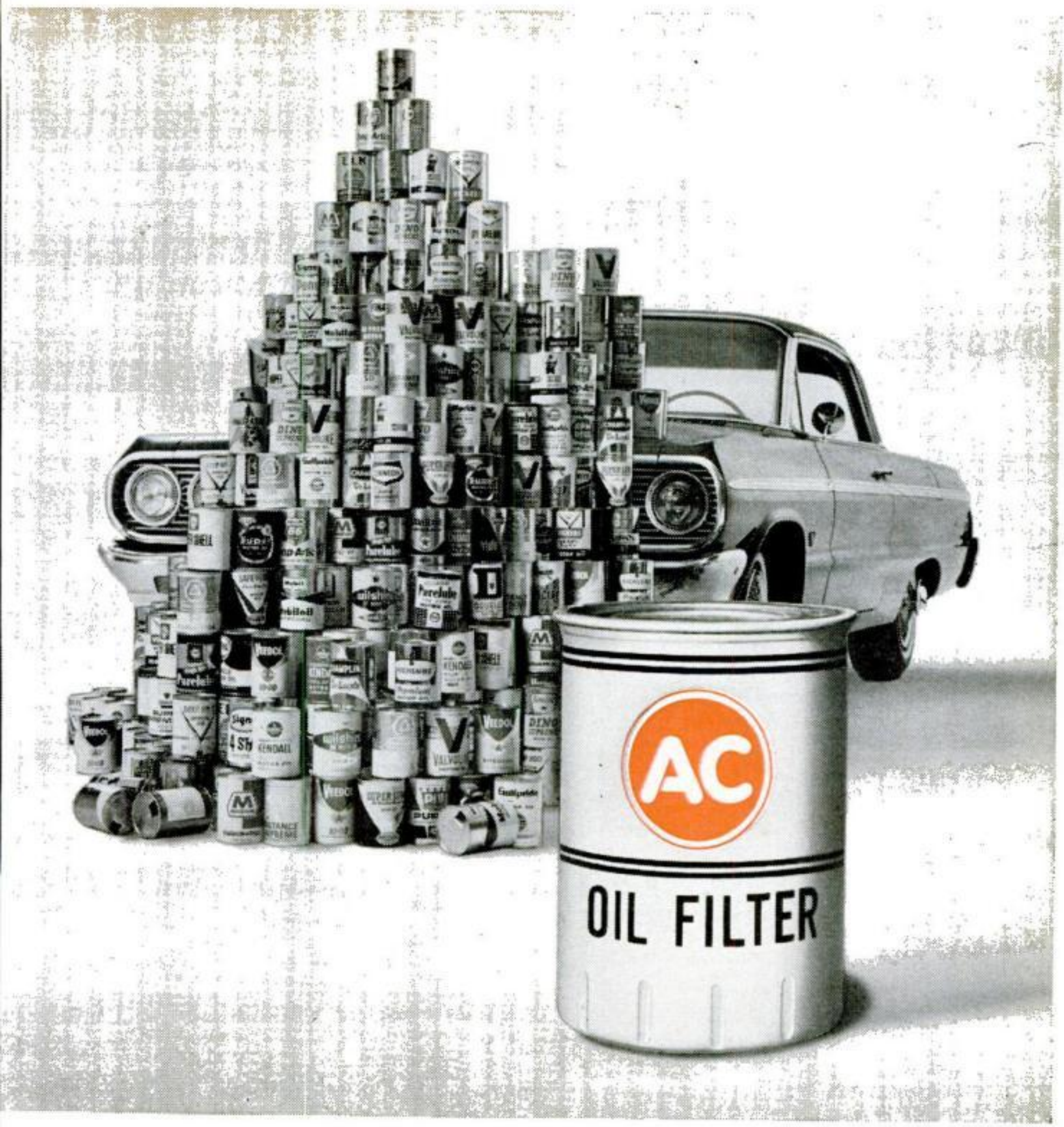

An AC Filter cleans 600 quarts of oil every hour*

As you drive, the AC Full-Flow Filter cleans your engine's oil at the rate of 600 quarts an hour. This means the oil in a 5-quart crankcase is filtered every 30 seconds. AC filtering action helps reduce engine wear — promotes longer car life. AC's exclusive filtering material takes harmful contaminants out, leaves helpful additives in. The oil stays clean, retains full lubricating qualities throughout the recommended service period. Next time you change your oil ask for the AC Oil Filter engineered specifically for your car.

*Average recirculation time.

AC SPARK PLUG ❀ THE ELECTRONICS DIVISION OF GENERAL MOTORS

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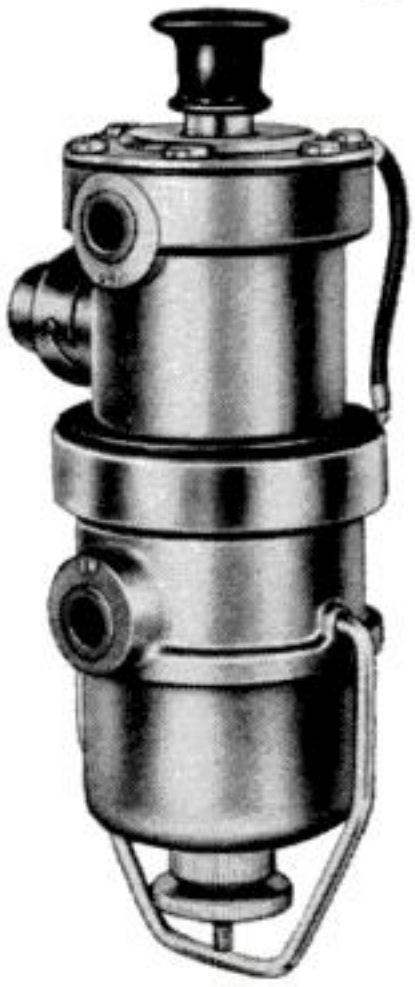
Cussing won't prevent stalling.

But a Stewart-Warner electric fuel pump will.



A S-W "240" Fuel Pump is a high-performance engine's best insurance against stalling due to vapor lock. Assures quick starts whatever the weather. Exclusive adjustable, automatic pressure-regulator keeps fuel flowing smoothly. Prevents starving and flooding. Line pressure adjustable up to 8 P.S.I.—delivers up to 60 G.P.H. For 6 or 12 volt systems. Your Stewart-Warner dealer will show you a S-W Electric Fuel Pump. You can count on it...from the makers of the most complete line of automotive instruments in America.

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Smokey Yunick continued

fade by the third time I hit them. I've always tried to break the linings in carefully, in flat country. I've changed linings four times in hopes of finding a type that won't fade. Can you suggest a cure?"—Lester Harlow, Orlando, Fla.

None of the standard-brand linings will resist fade under these conditions. When braking down the mountains in a heavy car it is possible to develop over 1,200 degrees of temperature in the linings, and the best of the regular brands overheat at 700. Switch to one of the sintered-iron types, developed for fadeproof stopping in road racing. Also, before driving in the mountains again, check all hydraulic brake lines and wheel cylinders, and be sure to change the retractor springs to the heat-resistant type now available.

►***"According to your June, '64, column, the U.S. limited-slip differential wears out rapidly. Since I find a Jeep necessary in my work as a veterinarian, would the above differential be a cause for more maintenance and repairs in this rough driving than the standard differential?"—W. E. Johnson, Maysville, Ky.***

My point was that the limited-slip differential adds unnecessary expense for *ordinary* driving. For really rough driving, the wear and tear saved on the rest of the drive train makes it an economical investment.

►***"My Lark 6, bought new in 1960, gave good service for the first 25,000 miles, at which time we installed new plugs, points, and condenser, and also had the timing and carb checked. Now, at 30,000, I have to shift on hills I climbed easily before." —F. A. Patrick, Harrisburg, Pa.***

The timing could be retarded too much. Have it rechecked, making sure the advance mechanism is working okay. If this doesn't revitalize it, get a compression check and see if any of the valves are burned.

►***"I would like to remove the positive-crankcase-vent system from my '64 Ford 390, but the shop manual states that the fuel economy will be adversely affected. Why?"—W. J. Kozak, Prospect Park, Pa.***

Modern carburetors are very touchy. Air-fuel ratios of the carbs are set with—and include the effect of—all components, in-

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Now!
Everything you need in a delivery truck tire at passenger tire prices

Why pay more—or settle for passenger tires—when the Firestone Transport nylon tire offers you full truck tire strength and durability for your pick-up and light delivery trucks? Mileage? We made it with our exclusive, long-wearing Sup-R-Tuf rubber compounds. Traction? We designed it with a deep, gear-grip tread that'll *stop*—and go—even on slick pavements. What's more, we backed it up with a rugged Shock-Fortified nylon cord body that'll *keep* you going when the going gets rough. Firestone Transport truck tires are now on sale at your nearby Firestone Dealer or Store. At passenger tire prices.

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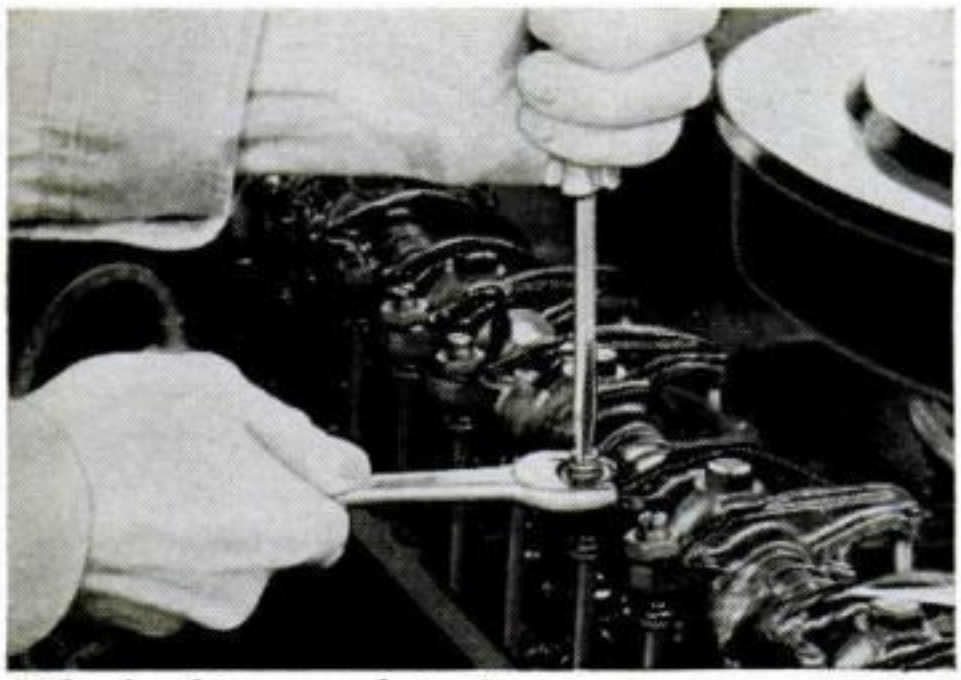


What's this man doing?

What does this symbol stand for?

Adjusting hydraulic valve lifters. The life preserver stands for Quaker State Motor Oil—the best engine life preserver for your car. Made from 100% Pure Pennsylvania Grade Crude Oil, Quaker State helps keep your car on the road and out of the repair shop. Keep your car running young. Insist on Quaker State Motor Oil. Always ask for it by name.

QUAKER STATE OIL REFINING CORPORATION
OIL CITY, PENNSYLVANIA

Smokey Yunick continued

cluding the positive crankcase vent. Anything you do to change any part of the system will upset the delicate calibration. Don't try it unless you are prepared to recalibrate throughout.

►***"The starter motor will barely turn the engine over on my '57 Nash after a 15-to-20-minute run, probably because it is close to the exhaust. I've had three different starters on it, but still have to wait about 20 minutes before I can start the engine." —Paul P. Krikorian, M.D., Dover, N.J.***

Most of the 1957 cars had starter motors just a little too small for the size of the engines. You could try fitting a metal plate lined with asbestos as a heat baffle to shield the starter. If that isn't enough, and the current starter motor is in good shape, try changing the system to eight volts. Get an eight-volt battery, see if the present regulator can be set to that, and if not, get one that can.

►***"The rear motor mounts on my '60 GMC pickup were replaced a year ago with an 'improved' set from a dealer. Now they're going to pot. Do you know of some make that will stand up?"—William C. Macdonald, Great Falls, Mont.***

The later-model mounts from GMC were improved. Your trouble probably comes from loose bolts holding them. Try using Loctite on the bolts after tightening to specified torque, or drill and safety-wire them so they'll hold correct pressure against the mounts.

►***"I have a '61 Chevy with the 283-in. engine and automatic. Can I change the ring gear and pinion for power to pull a heavy boat trailer? Which combination should I use?"—R. Wilcox, Portland, Ore.***

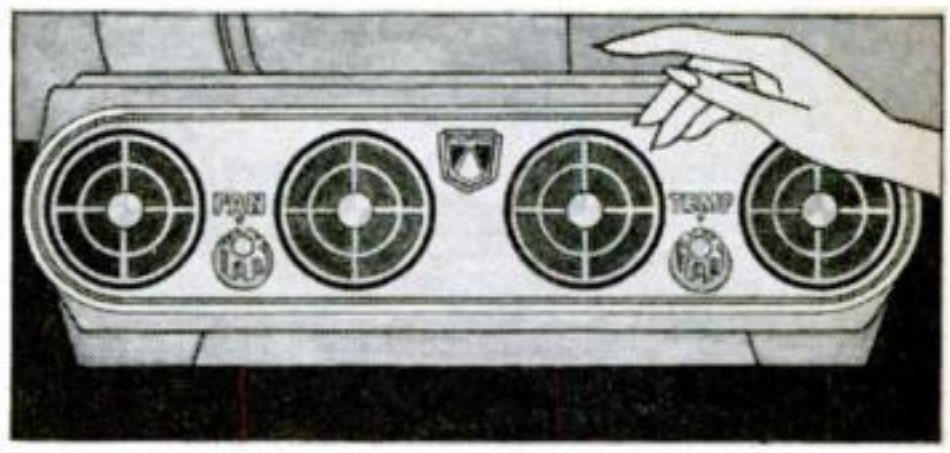
Yes, that's a good idea. If it is available for that model, get the 3.54:1 set. You could even go to the 3.63:1 ratio, which will give you far better results than the 3.36:1 you now have.

• • • •

Who's got everything for your Ford

from Oil Conditioners...

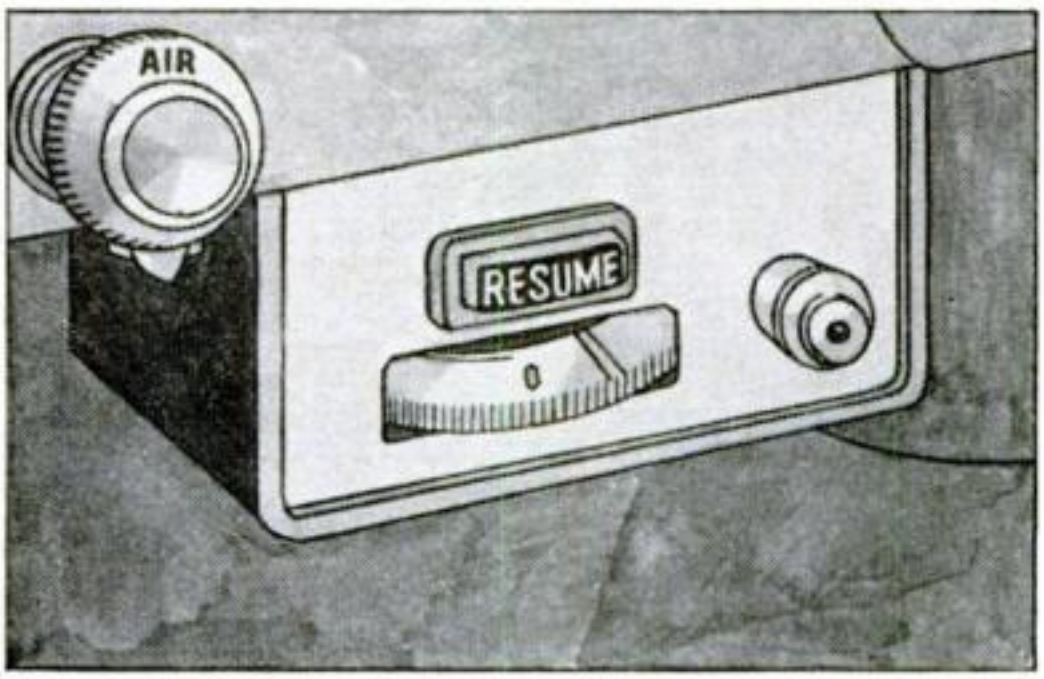
Put Rotunda Oil Conditioner in your crankcase during oil changes. It reduces harmful sludge and varnish deposits in your engine, helps prevent valve and ring-sticking, improves oil flow. 16-ounce can $1.25*



to Air Conditioners

For the most in summertime comfort, have a Ford air conditioner installed in your car. This attractive, easy-to-operate unit offers exceptionally high performance — fast cool-down — cools, cleans and dehumidifies the air. $240.00*

Speed Controls...



Enjoy the convenience of driving at a constant speed with your foot off the accelerator. All you have to do is just set the dial. The automatic speed control keeps you traveling at a constant speed, will automatically cut off when brakes are applied. $71.40*

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These strong, nylon belts come in seven interior-harmonized colors. They can be released instantly with one hand, yet are capable of withstanding 5000 lbs. of pull. From $5.30* each.

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3" ASTRONOMICAL REFLECTING TELESCOPE
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Equatorial Mount with lock on both axes. Aluminized and over-coated 3" diameter high-speed f/10 mirror. Telescope comes equipped with a 60X eyepiece and a mounted Barlow Lens. Optical Finder Telescope included. Hardwood, portable tripod. FREE with Scope: Valuable STAR CHART plus 272-page "HANDBOOK OF HEAVENS" plus "HOW TO USE YOUR TELESCOPE" BOOK.

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4¼" Astronomical Reflector Telescope!
255 Power. New Vibration-Free Metal Pedestal Mount.
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Superb 6" Reflector Telescope
Up to 576 Power Equatorial mount and Pedestal Base
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POWERFUL 2000 GAUSS GAP MAGNET

Recharge old magnets, de-magnetized magnets, temporarily magnetize small hand tools without weakening gap magnet. Simply pass through gap field. Does not magnetize to saturation point. Efficiently handles magnets up to ¾" diam. x 1-3/32" long. Level portion on base 2" lg. x 1" w. has 2 holes, tapped with 10-32 thread, for easy rigid mounting. 5⅞" lg. x 3⅞" high x 1-3/16" thick. Wt. 3 lbs., 4 oz.

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Projects illustrations up to 3" x 3½" and enlarges them to 35" x 30" if screen is 6½ ft. from projector; larger pictures if screen is further away. No film or negatives needed. Projects charts, diagrams, pictures, photos, lettering in full color or black-and-white. Operates on 115 volt, A.C. current. 6-ft. extension cord and plug included. Operates on 60-watt bulb, not included. Size 12" x 8" x 4½" wide. Weight 1 lb., 2 oz. Plastic case with built-in handle.

Stock No. 70,199-N.....$7.95 Postpaid

OPAQUE PROJECTOR with KALEIDOSCOPE ATTACHMENT
Same unit as above, but provides endless additional projects with everchanging kaleidoscope patterns.
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NEW WORKING MODEL DIGITAL COMPUTER
ACTUAL MINIATURE VERSION OF GIANT ELECTRONIC BRAINS

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7 x 35 American Made Binoculars
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6 x 30 Binoculars—similar to above and a terrific bargain.
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70,004-N	6"	1"	11.95 ppd.	
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70,006-N	10"	1¾"	30.75	f.o.b. Barrington
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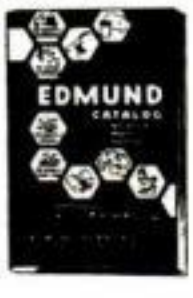

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Great idea! Fascinating fun and sometimes tremendously profitable! Tie a line to our 5-lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along the bottom—your "treasure" haul can be outboard motors, anchors, fishing tackle, all kinds of metal valuables. 5-lb. Magnet is war surplus—Alnico V Type—Gov't. Cost, $50. Lifts over 150 lbs. on land—much greater weights under water. Order now and try this new sport.

Stock No. 70,571-N 5 lb. Magnet.....$12.50 Postpaid
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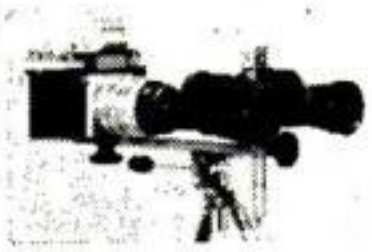

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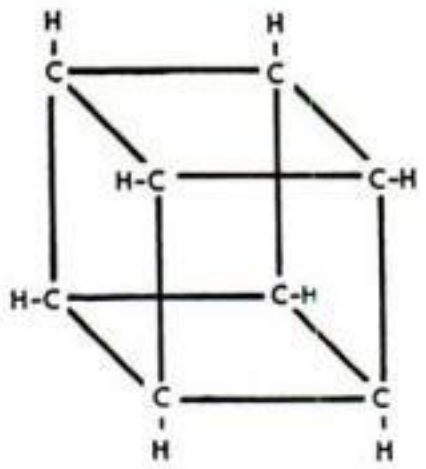
SCIENCE *Newsfront*

BY WALLACE CLOUD, PS SCIENCE EDITOR

At last—chemist builds a molecular box

Chemists sometimes think about molecules as if the atoms in them were Tinker Toys, but it isn't always easy to make the atoms go together in the test tube the way they ought to. A cubical molecule of carbon atoms has



Cubane

been imagined for some time, but attempts to synthesize it were unsuccessful until recently.

Now Dr. Philip E. Eaton, a 28-year-old chemist at the University of Chicago, has succeeded in making "cubane," a box-shaped molecule with a hole in the middle.

No one is sure what cubane will be good for, but drug researchers think it may help in making an antivirus drug. It may also be useful in pesticides, fungicides, and herbicides.

Portable airport

Spraying a plastic landing field on the ground may turn out to be the answer to one of the problems of flying vertical take-off and landing planes.

VTOL aircraft, especially those using downward-aimed jet engines for lift, kick up dirt and rocks that may damage their engines. If they are to operate from such improvised sites as jungle clearings, it may be necessary to harden the ground.

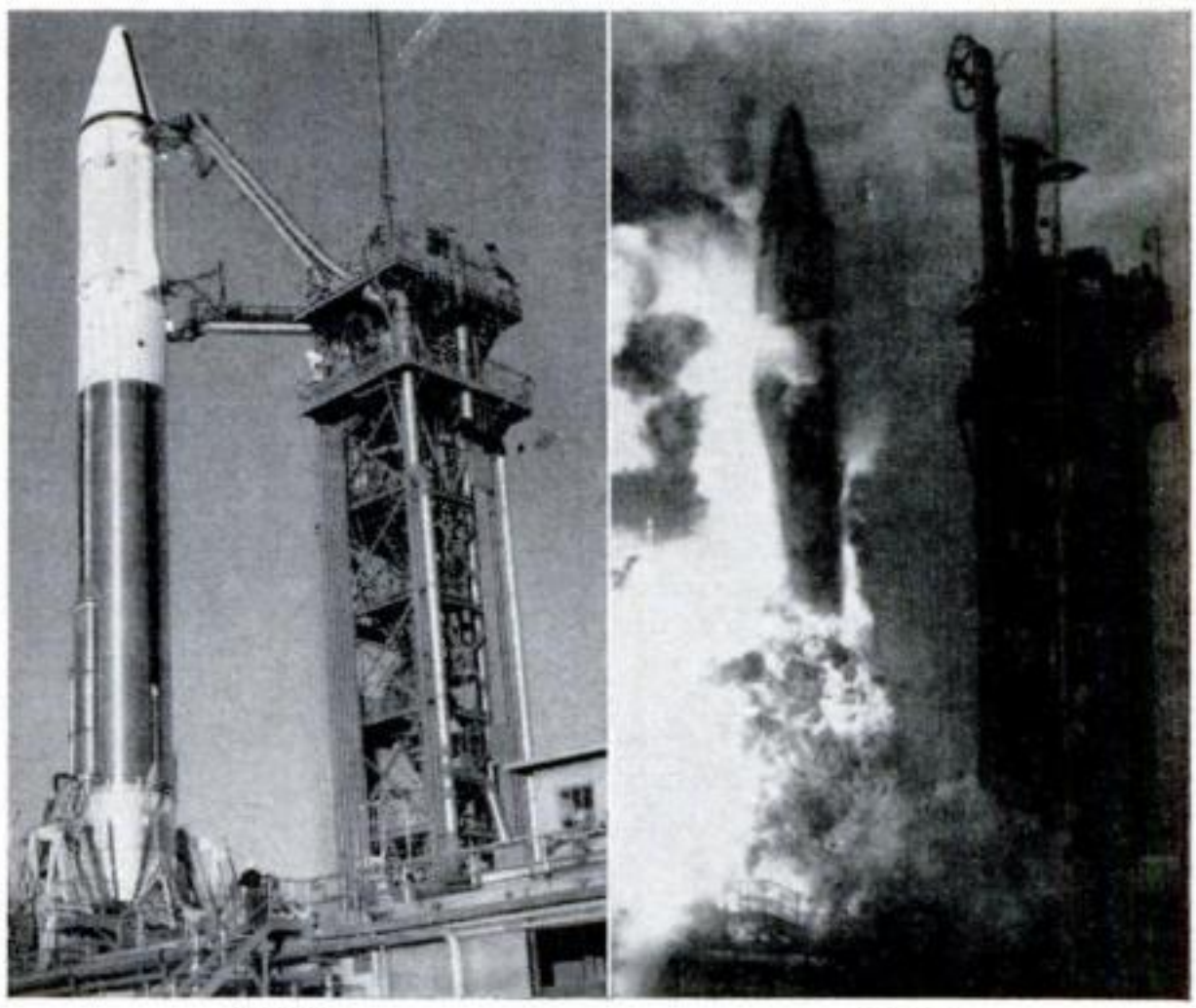
Ling-Temco-Vought, one of the developers of a tilt-wing plane for the Air Force, has successfully demonstrated a polyester-fiberglass mixture that can be sprayed from a jeep or from the VTOL plane itself, and will harden in 15 minutes in tropical or arctic climatic conditions.

Fighting onion

A plucky onion that resists thunderstorms has been developed by the University of Wisconsin.

It seems that in the perilous life of the onion, a hazard is "tipburn," caused by ozone accumulating on plant tips during thunderstorms. That's a serious problem among Midwest onion farmers.

The thunderstorm-fighting onion, bred by biologists at Wisconsin, is a dark-golden global type, called Sunburst. Its tips don't burn.



Before **After**

Booster blast: snag for U.S. moon race?

The explosion of the Atlas-Centaur rocket that was to carry a dummy Surveyor moon robot toward a "paper moon," at Cape Kennedy March 2, may not set back the U.S. moon program. That's the hope of the National Aeronautics and Space Administration, but it will be touch and go.

Flame-out of two of the three engines on the Atlas booster stage let the rocket

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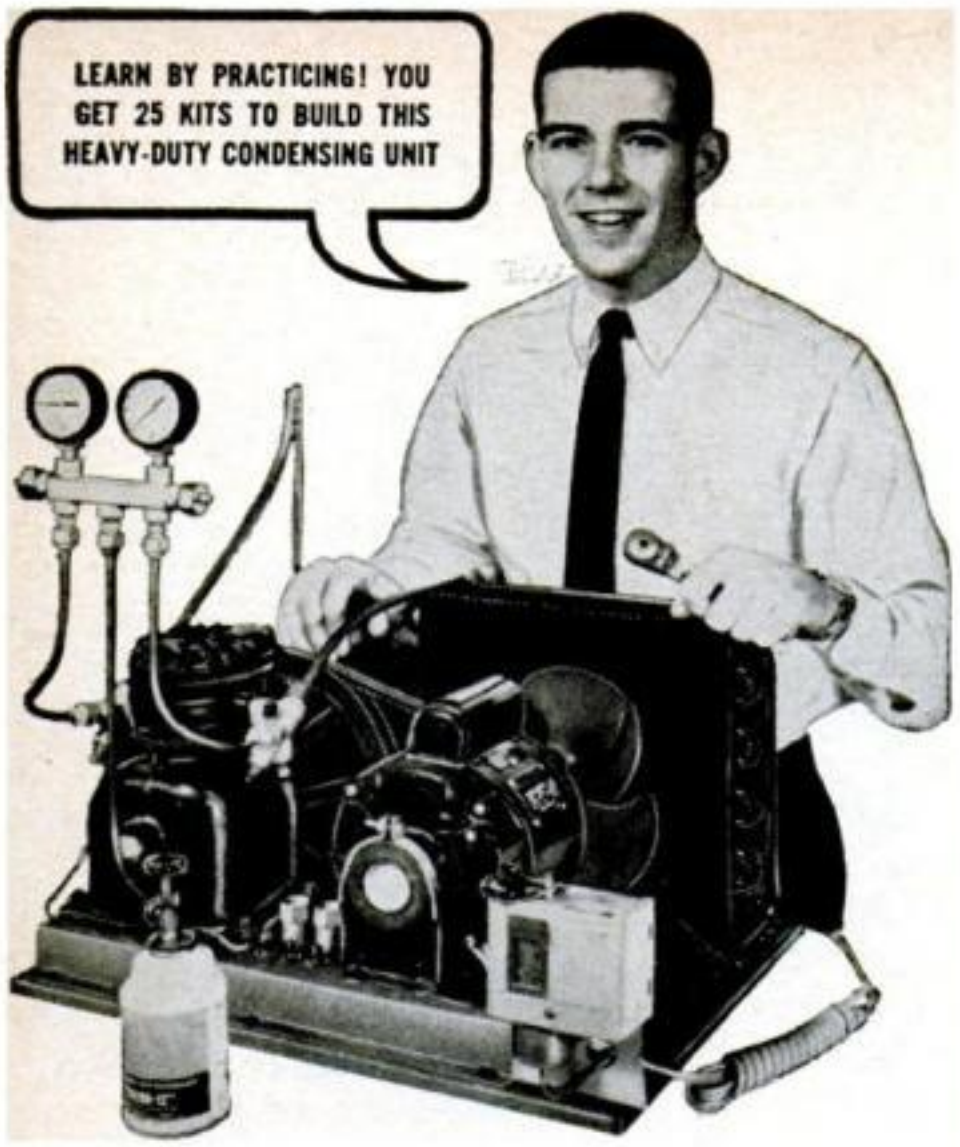

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Science newsfront continued

drop back on the pad two seconds after liftoff, and it exploded. The fireball of kerosene and liquid oxygen, the Atlas propellants, set off the liquid hydrogen and liquid oxygen in the Centaur upper stage.

Although the engine failure took place in the Atlas booster, this explosion fits in with the kind of luck NASA has been having with the Centaur stage. Almost everything that could go wrong with Centaur has, but it is considered important to develop the tricky technology of hydrogen-fueled rockets, since hydrogen is a lightweight, ultra-high-energy fuel.

Both Centaur and Surveyor are crucial to the success of the U.S. moon program. The manned Apollo mission also depends on a hydrogen-fueled upper stage, and information from Surveyor landings is necessary to complete design of the lunar "bug" that will land the first men on the moon.

The launching was to have propelled an incomplete Surveyor to a point in space where the moon will be next September. At that time, the first actual Surveyor was to land gently on the lunar surface, to take a ground-level TV look around.

NASA hopes to meet its schedule even though there is no other launch pad capable of handling the Atlas-Centaur combination. It will take a crash effort to get another pad ready or repair the heavily damaged one.

Why alcoholics are addicted

Alcoholism has been shown to be an addiction in the same sense as drug addiction, rather than a behavior pattern based exclusively on emotional problems, says Dr. Marvin A. Block, an official of the National Council on Alcoholism.

In a publication of the American Medical Association, Dr. Block described research at Georgetown University in which human cells grown in the test tube, after becoming adapted to alcohol, were "convulsed" when alcohol was withdrawn.

The research was similar to earlier work in which cells grown outside the body were accustomed to narcotics, then became sick or died when drugs were taken away.

A conclusion from this research is that the withdrawal symptoms suffered by alcoholics, when they are deprived of alcohol, are not significantly different from the with-

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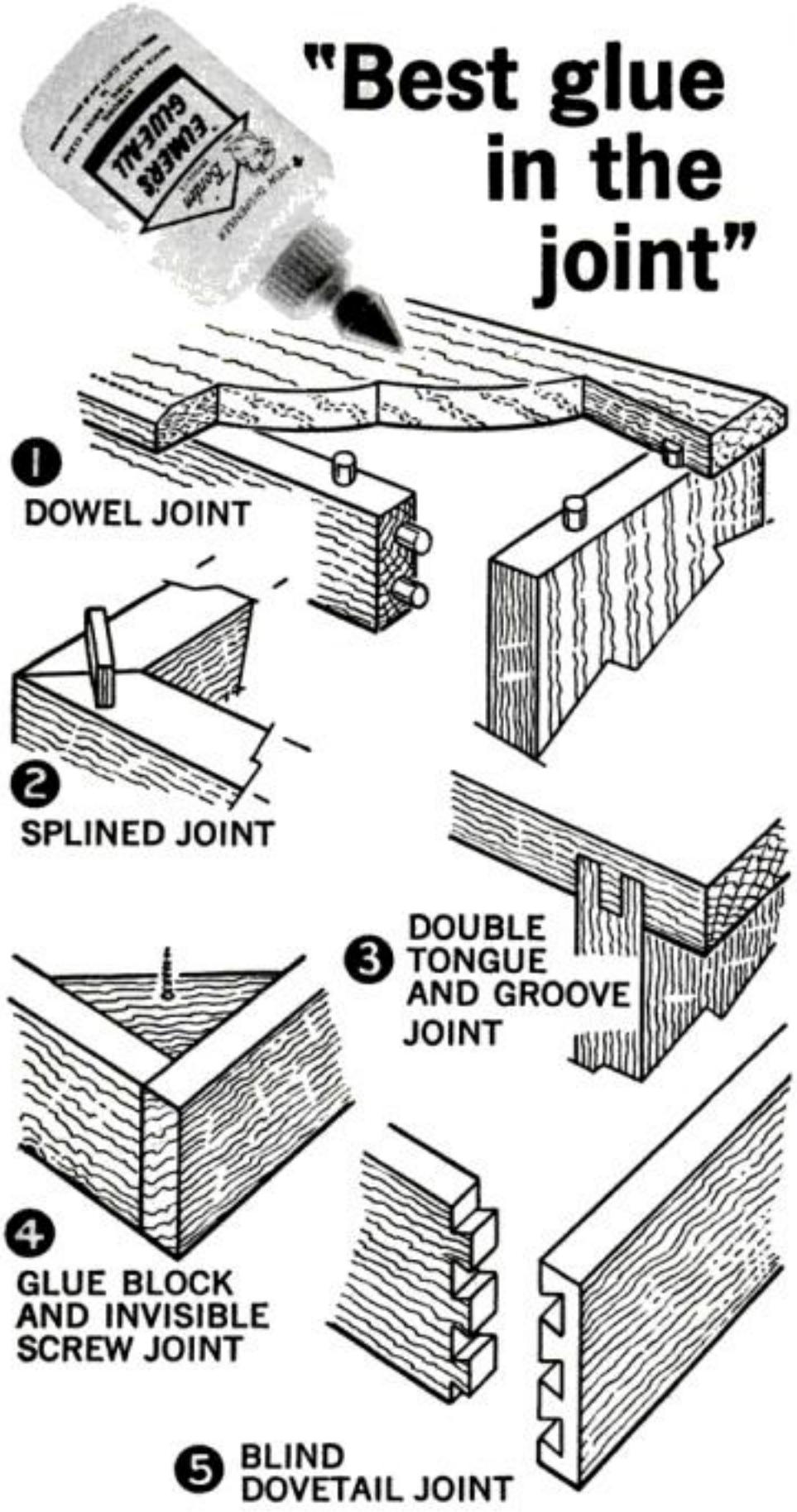
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drawal symptoms shown by drug addicts.

Moreover, once the cells have become addicted but then have gone without alcohol for some time, drinking triggers the old dependence on alcohol. This helps to explain why a reformed alcoholic can never indulge in social drinking.

Why some drinkers become addicted and others don't is still not understood. It may be that some people have a built-in physiological tendency to become addicted. Or the adaptation of cells to alcohol may be something that can happen to anyone if emotional problems lead to uncontrolled heavy drinking.

Lemmings: antisocial but not suicidal

Lemmings don't march into the sea, says Dr. Charles J. Krebs of Indiana University —or at least he didn't see any such mass suicides in a study of the four-year lemming population cycle in Northern Canada.

The number of lemmings in an area does vary wildly from year to year, Dr. Krebs observes. The population may increase up to 50 times in a peak year.

This is because the lemmings, which breed under the snow during winter, are ready to reproduce at the age of three weeks, and produce litters of nine after a pregnancy lasting only three weeks.

In peak years, lemmings do crazy things. They dash madly about, overrun human dwellings, go swimming in lakes and streams, and run far out on sea ice. But Dr. Krebs says stories of mass migration into the sea have never been confirmed by scientific observation. Lemmings are not really very sociable, he says.

What happens to the lemmings to reduce their population drastically after a peak year is still unknown, however.

Chinese typesetting by machine

The ancient problem of setting Chinese type has been solved in a stroke by an RCA computerized photocomposing system. The Chinese invented movable type, but were stuck with the headache of 8,500 separate characters to set up for printing. The RCA machine actually "writes" the Chinese characters on photographic film, to be transferred to a printing plate, using combinations of 21 basic strokes, 20 complete symbols, and 11 punctuation marks. ■ ■

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GETTING AHEAD

A monthly column to help you prepare yourself for a better job

By Dr. Lewis R. Fibel

THINKING of changing your job? Consider yourself normal. Recent studies show that the working life of men in the U.S. is characterized by a sequence of job changes. These figures (from a U.S. Department of Labor study) illustrate the point:

Age	Expected job changes during remaining work life
20-24	6.6
25-34	4.3
35-44	2.7
45-54	1.4
55-64	0.6
65 and over	0.2

These figures point up the need for broad initial training so you'll have the flexibility to meet changing job demands, whether you're going up or moving sideways into another slot. Better training and occupational guidance might also make it easier for young men to reduce some of the trial and error involved in finding the right job.

"How can I have my IQ measured? What does it really mean?"—E.F., Wichita.

Many readers ask about IQ tests, so answering your question rather fully may help others. The most common variety is the mental-ability test. The result is expressed as an Intelligence Quotient, or IQ—briefly, a symbol for how well you did on a certain test in comparison with others. In general, the average IQ is 100; half the population will have higher scores, half will have lower scores.

There are several tests in use. Scores made by the same individual on different tests are not always the same (although there are tables that permit translation of scores from one scale to another). Most experts feel, therefore, that an IQ score must be interpreted within a fairly broad range, rather than as an exact score.

IQ is a measure of academic ability. It does *not* measure whether you might be a good engineer, electrician, or draftsman, but whether or not you will *probably* get good grades in an engineering, trade, or technical school. With an IQ of 90, for example, you'd have, perhaps, one chance in 1,000 of succeeding in an engineering school—although other factors, difficult to measure (motivation, for example), have a bearing.

"I graduate from college this year and want to join the Peace Corps. My father says this is crazy—a waste of time. Is it?" —C.D., Houston, Tex.

Could be—it depends on you. If you're looking for romance and adventure, forget it. If you are eager to contribute to a growing country the technical skills and democratic attitudes of America, consider the Peace Corps. If you are ready to work 16 hours a day for little money, live the life of ordinary people in a backward country, and feel rejected more often than accepted, consider the Peace Corps.

What's in it for you? The opportunity to make a contribution toward peace, to gain a basic understanding of foreigners that touring can't give you, and to know yourself, discipline yourself, and learn how to cope where things are toughest.

"I'm 29 years old, had one year of college, and I'm thinking of going back to study engineering. Will I be too old, when I get out, to start as a junior engineer?" —A.B., Toledo, Ohio.

There's no simple answer to this one—a problem facing many readers. Each has to weigh the facts as they apply to him.

If you go back to college full time, you'll be 33 or 34 when you graduate. I don't think that's too old to get a job as an engineer. I know many men who started a new career at that age. In this rapid-change era, more important than *your* age, is the age of your education. Your shiny new diploma, plus the steadiness of your maturity, should be in your favor.

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Mercury also designed a new suspension that "floats" the engine cowling on large, soft-rubber mounts. This prevents the normal working noises of the powerhead from being "picked-up and broadcast" by the cowling surface. To make sure that sound remains trapped inside, the cowling was made "sound-tight" by rubber-sealing all openings for controls and fuel lines.

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Getting Ahead continued

"Are there any colleges that offer a four-year course in radio engineering?"—W.A., Winchester, Va.

This is a tough one to answer because I don't know what you mean. I know of no colleges that offer that specific program. The classification that would include the design of radio systems is electrical engineering (including electronics—radio, TV, radar, etc.). There are over 100 accredited programs in this area.

Or are you thinking of the engineering department of a broadcasting station? The basic position there is that of broadcast technician (sometimes the term "engineer" is used). To be a broadcast technician, you must hold a Radiotelephone First Class Operator's License from the FCC, acquired by passing a series of written examinations. Good preparation is an electronics course in a technical school; many schools give courses designed to prepare you for the FCC test.

"I'm 39 years old, and leaving the Army after 20 years' service. I hold a master sergeant's rating in the Signal Corps and will get a half-pay pension. Do you have any suggestions about where I go from here?"—G.H., Fargo, N.D.

Just about anywhere you want to, I'd think. With your pension, you have some independence—you don't have the financial problems other men of your age would have. I don't know what your interests are, but if I were in your shoes, I'd consider some small business that would leave time free to travel, read, paint, or otherwise enjoy life.

A number of possibilities come to mind: TV repairing, sharpening saws and mowers, locksmithing, electrician, owning and operating a bulldozer or small truck, some selling jobs. Running a store—your own or a dealership—can give you plenty to do, and electronics parts or photo supplies might be right up your alley.

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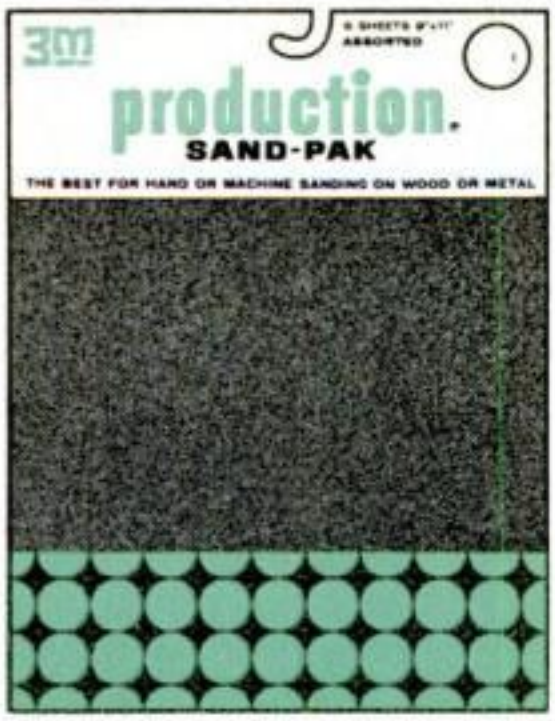

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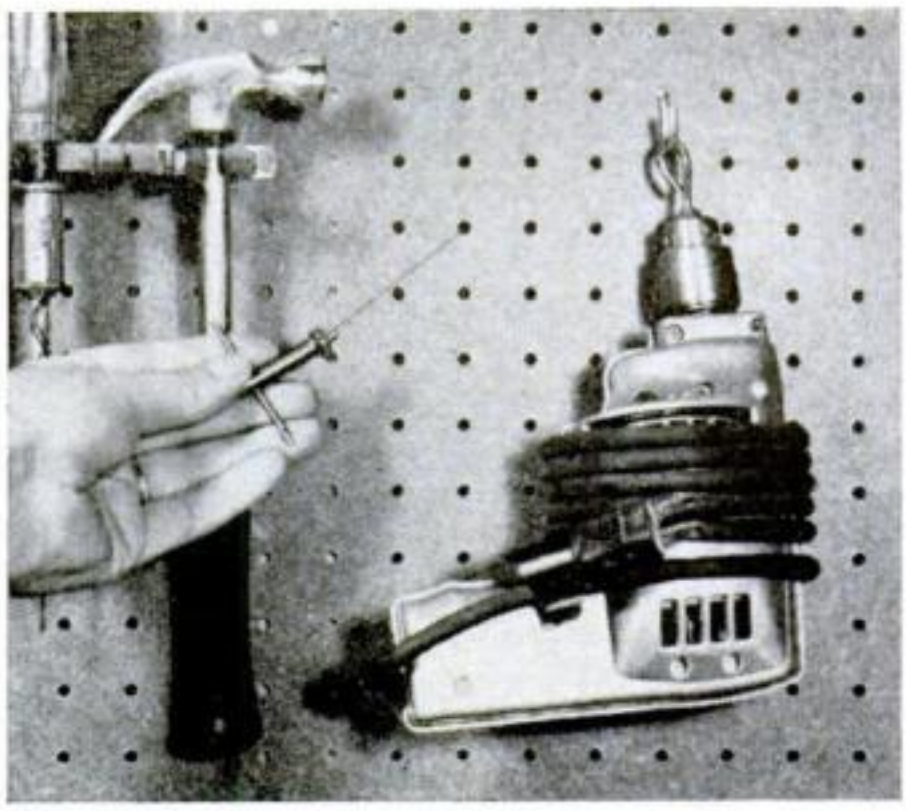
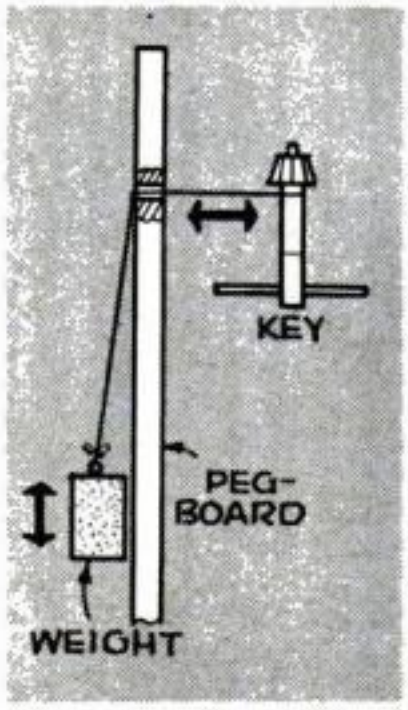


Retracting chuck key can't get lost



You aren't likely to misplace your chuck key or leave it in the chuck with this trick. The key is tethered on the end of a length of nylon fishline passed through a hole in the tool panel and tied to a weight in back. You pull the key out to use it, then let go and the weight automatically snaps it back in place.—*Don Anderson, Phoenix, Ariz.*

▶▶▶To make a small sign in a hurry, dip a filter-tip cigarette in a bottle of ink. It's amazing how much the filter will hold. The ink is released evenly, and I had no trouble with drips or splotches.—*Stephen N. Stresnic, Fort Lauderdale, Fla.*

Splashproofing an outside faucet

Outside sill cocks often splash water because they have a very short spout. Cut a short length from the female end of an old garden hose and screw it on the faucet. It will extend the spout and end the spattering.—*Kenneth S. Ferrin, Sunnyvale, Calif.*

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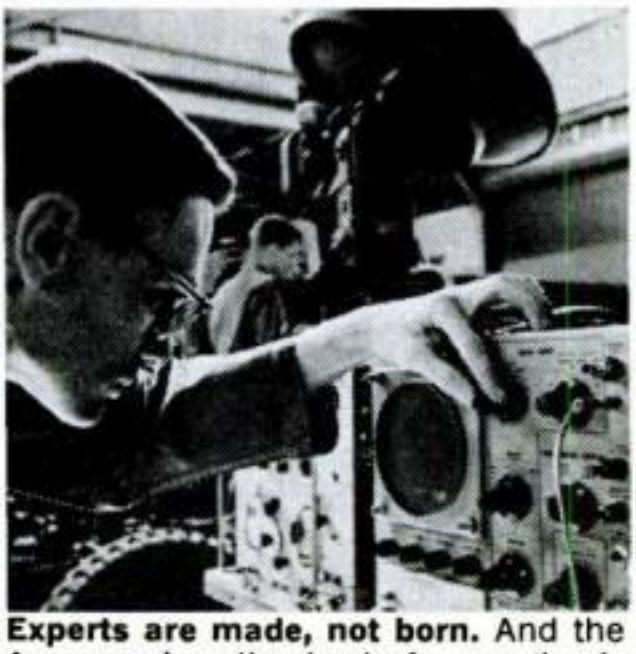
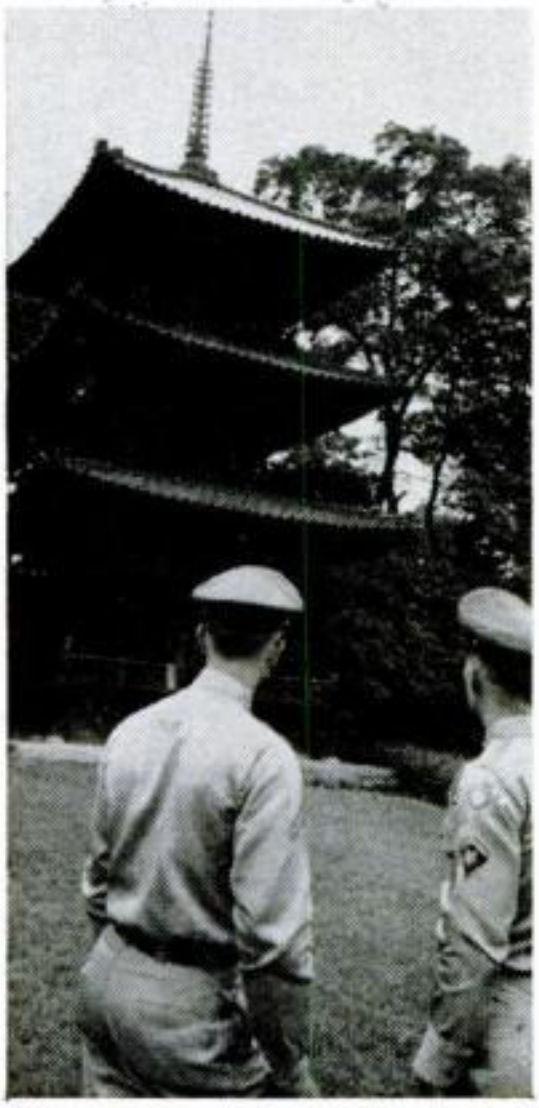


Experts are made, not born. And the Army makes the best. Army schools teach hundreds of different specialties. If you qualify, you can sign up for the one you want before you enlist.

It's different from your home town. And who wouldn't expect it to be? After all, one of the reasons you join the Army is to see the world of differences.



You're not alone in today's action Army. Every experience you have is shared with other great guys. Regular guys who are learning, earning, growing, going, serving our Country, developing themselves. Just as you are.

But the wonder of these experiences is yours alone. No one can tell you how great it feels to master a difficult specialty like computer programming, missile repair, electronics, or construction. No one can live the excitement of landing in a foreign country for you. No one can know what *your* great moments in the Army will be. But you can be sure your life in today's Army will be full of great moments. Enough to add up to a great life.

Talk to your local Army recruiter. Let him tell you what the Army can do for you... and what you can do for the Army. Let him help you to that great moment, the moment you realize that...if you're good enough to get in, a proud future can be yours in today's *action* **Army**

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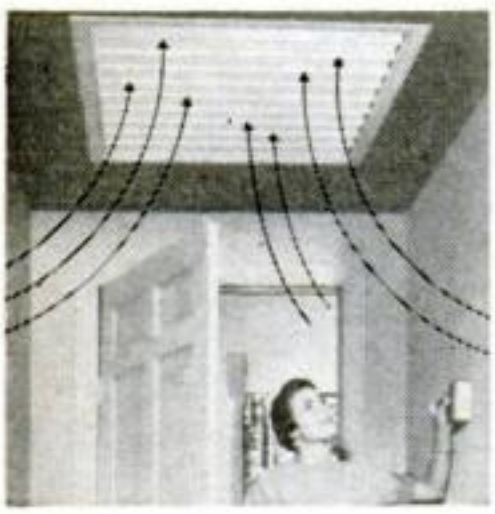

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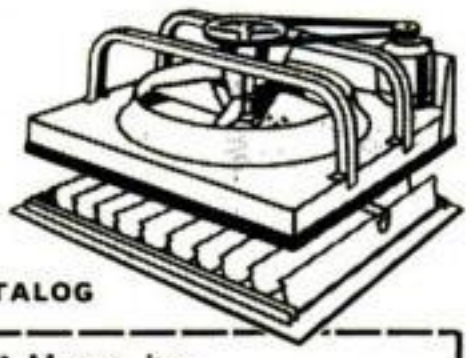

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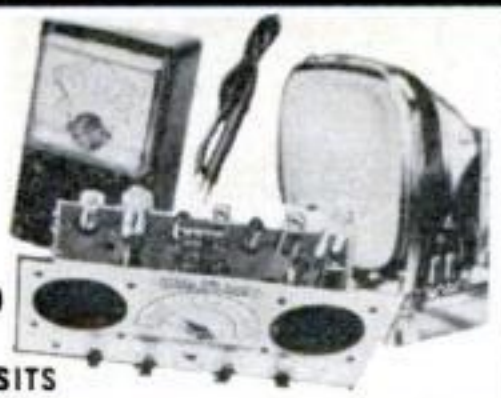

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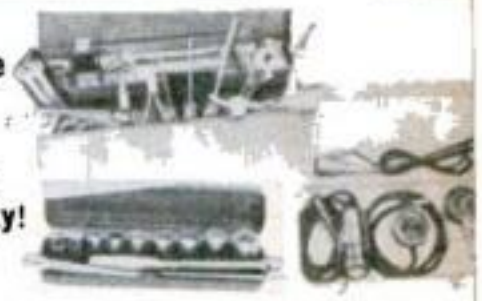

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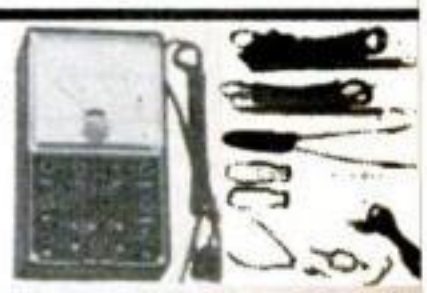

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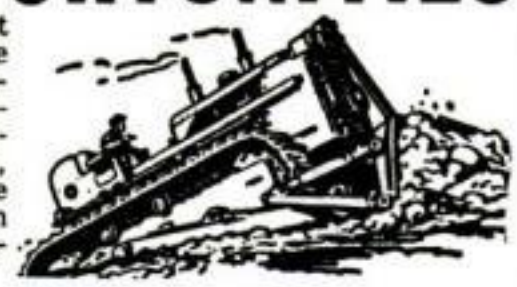

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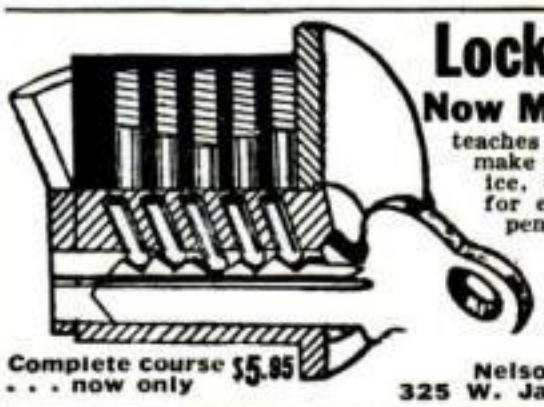

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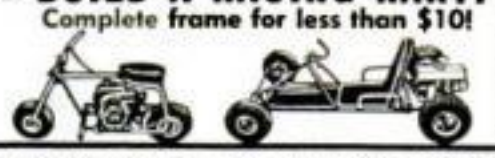

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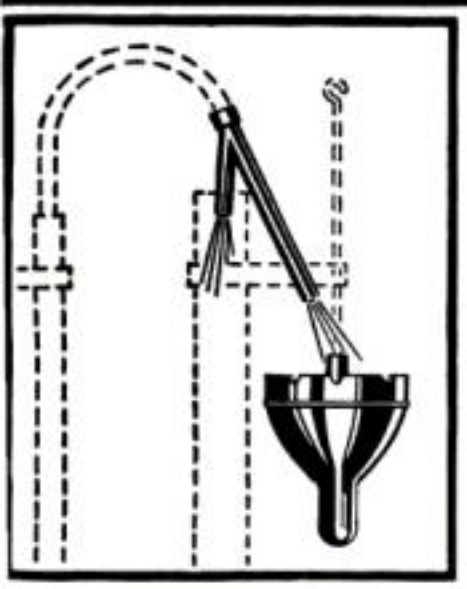

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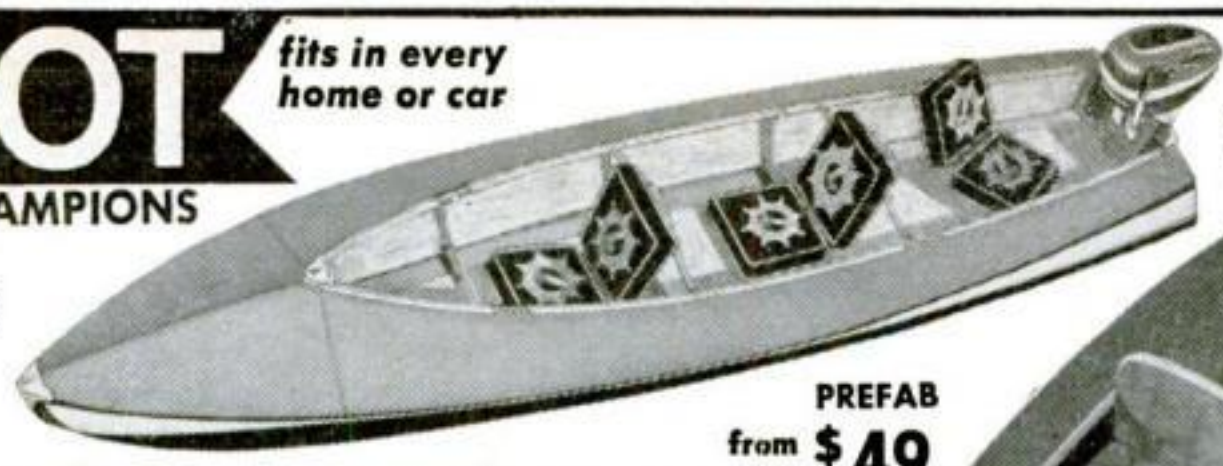

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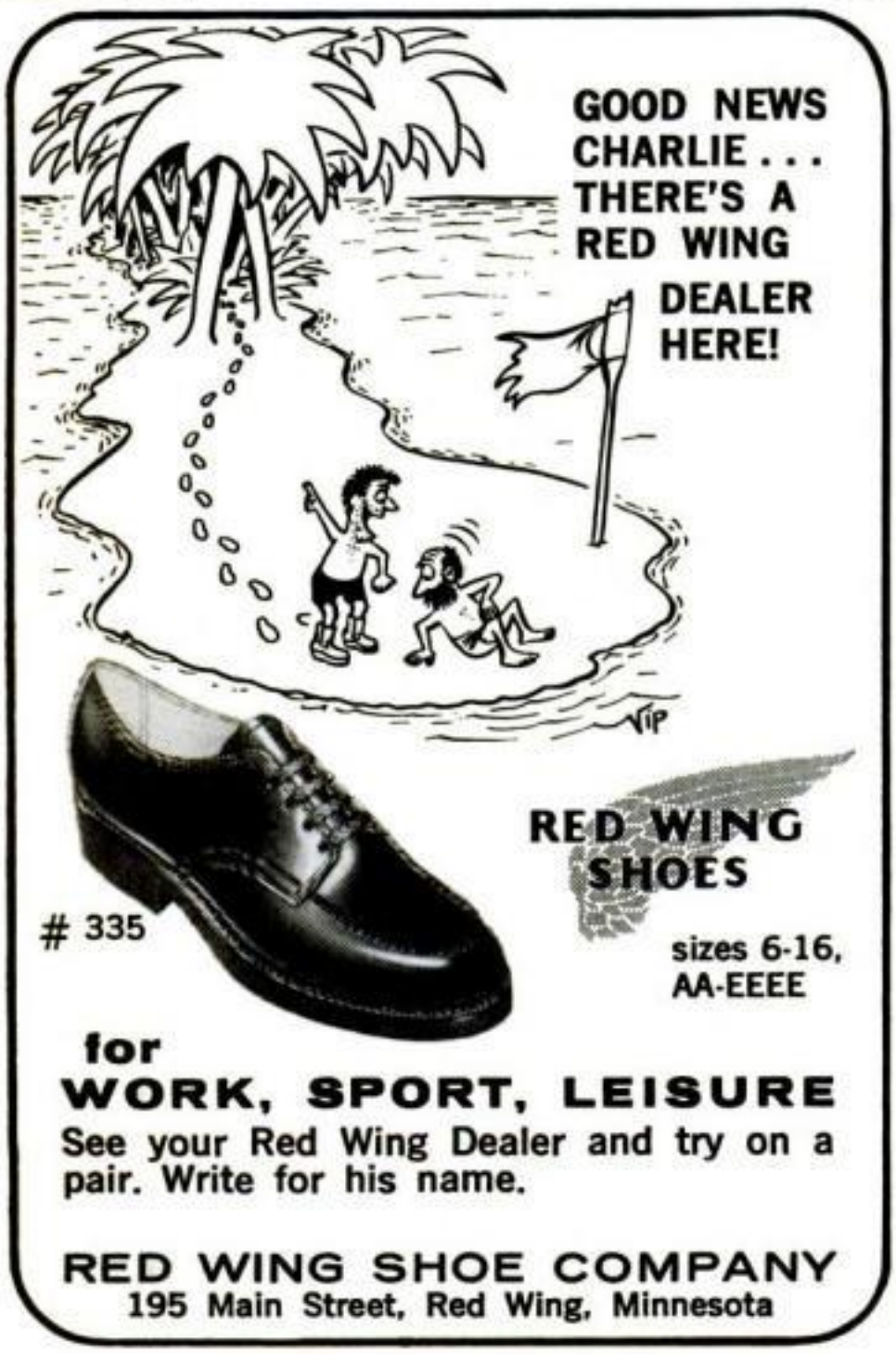

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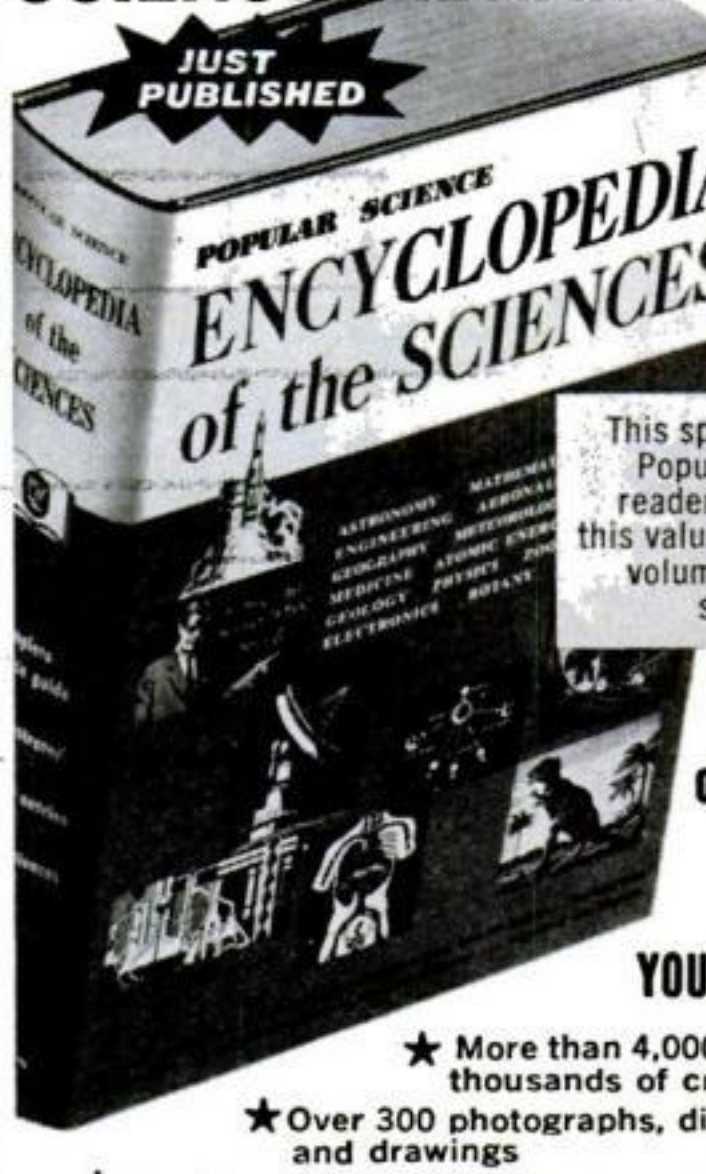

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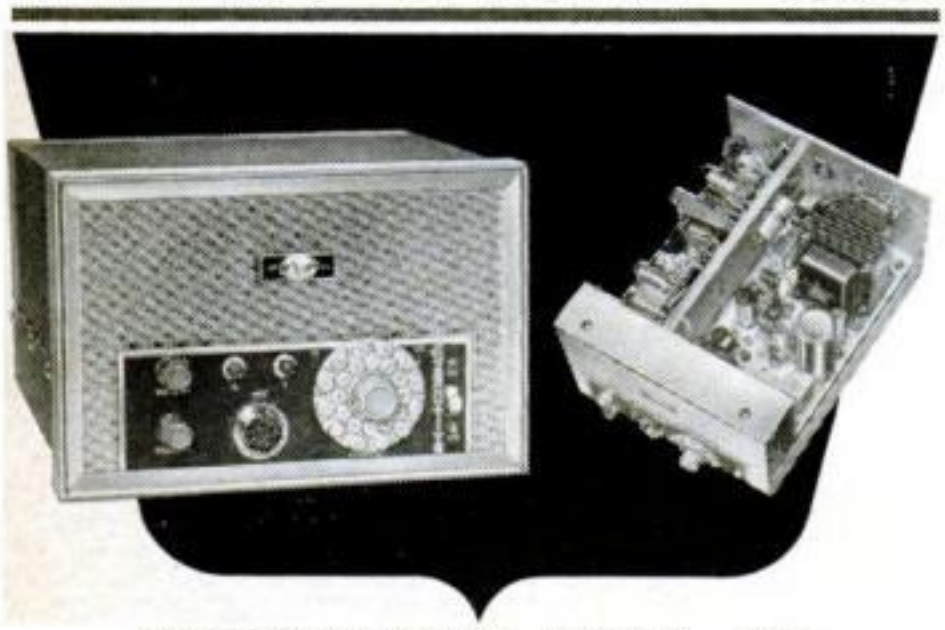

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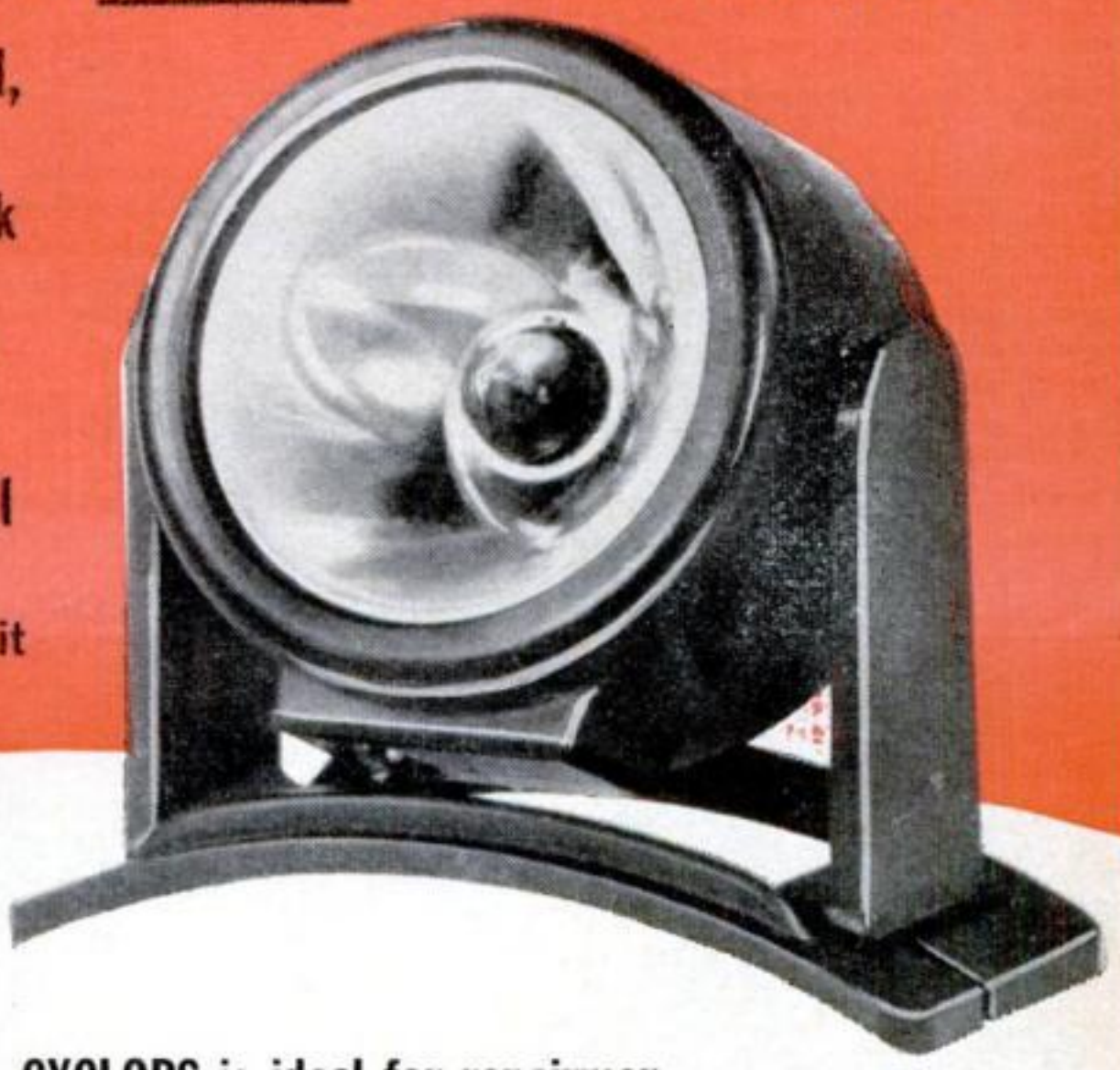

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Detroit report...

WATCH FOR AN OVERHEAD-CAMSHAFT PONTIAC. Ford has been first to release details of a new overhead-camshaft V-8, but Pontiac has been experimenting with overhead camshafts for years. A year ago Pontiac seemed ready to introduce an in-line six with a belt-driven overhead camshaft, but didn't. Now Pontiac is readying a V-6 with an overhead camshaft to each bank of cylinders.

Engine developments for 1966 run in two directions: larger displacement and higher efficiency. The interest shown by Ford and Pontiac in overhead camshafts is significant, as they offer three important advantages: fewer reciprocating parts in the valve train, lighter valve-spring loads, and lower production costs. The drawback? There is no durable and efficient overhead-camshaft drive that works silently. Belt drive may be the solution, and Hans Glas of Dingolfing in Germany has been building small automotive engines with belt-driven overhead camshafts for some years with good results. Now Pontiac is developing the idea for use on big-car engines.

Power boosts in Cadillac, Imperial, and Lincoln are on the way. Lincoln engineers are readying a 462-cu.-in. powerhouse for the Continental, to replace the present 430. The new engine is essentially a bored-out version of the existing unit, with horsepower boosted above the 350 mark (vs. this year's 320). It is also beginning to occur to some Ford executives that all Lincolns are Continentals these days, and that time may be ripe for a Lincoln Lincoln. Cadillac's 429-cu.-in. V-8 will keep its displacement, but power will go up to about 365 hp. There are no immediate plans for taking the V-12 design (which nearly made it into production last year) off the shelf. Imperial will up the 413-cu.-in. V-8 to something over 450, with a power output around 375 hp.

Other power-unit news: The big 390-cu.-in. Ford V-8 will become optional for the 1966 Comets and Fairlanes. Installation will involve some changes in exhaust manifolding to fit the package into the smaller engine compartments. Chevrolet will bring its base-model six up from 230 cu. in. to 263. The Pontiac in-line six will, presumably, be replaced by the new V-6. Another V-6 will be announced by Chrysler. Basically a light truck engine of around 300 cu. in., it may become available in the Valiant/Dart lines, replacing the obsolescent 225-cu.-in. slant-six.

Plymouth Belvedere and Dodge Coronet will get a completely new look this fall. They will continue as intermediate-size models and retain the unit-construction bodies, but the outer sheet metal will be all new. Other changes (finally): curved side glass and wider interiors, smoother roof lines, more subtle side sculpturing.

Chrysler's Imperial models will be built on the Chrysler body next year in a move to cut manufacturing costs to a more competitive level. The present body style, with a separate frame and body, will be discontinued. Instead, the Imperial will be given some special styling treatments on the unit-construction Chrysler body.

GM's 1965 styling theme has proved extremely successful, and the full-size Chevrolet, Oldsmobile and Buick will have only minor facelifts for next year. But Pontiac is making plans to renew the complete skin again for 1966. Also, Ford's Thunderbird is due for a complete restyling, with a four-door coming in 1966.

The 1966 Comet will be upgraded to stress its separate identity from the Falcon. Its brand-new body will be bigger, sharing a basic structure with the Fairlane. It features such styling details as a horizontally split grille (like last year's Cadillac and the new Marlin), vertically stacked headlights with the top rim reaching above the fender line (like the '65 Ambassador), and new bumper and light arrangements in line with current FoMoCo practice. Dimensions, roof lines, and fender lines are very close to the BOP-Chevelle group. The engineering of the new Comet offers little news—the car will retain its coil-front, leaf-rear suspension system.

Jan P Norbye
Automotive Editor

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Graham Hill wins the U.S. Grand Prix at Watkins Glen in a BRM sparked by silvery-plated Champions

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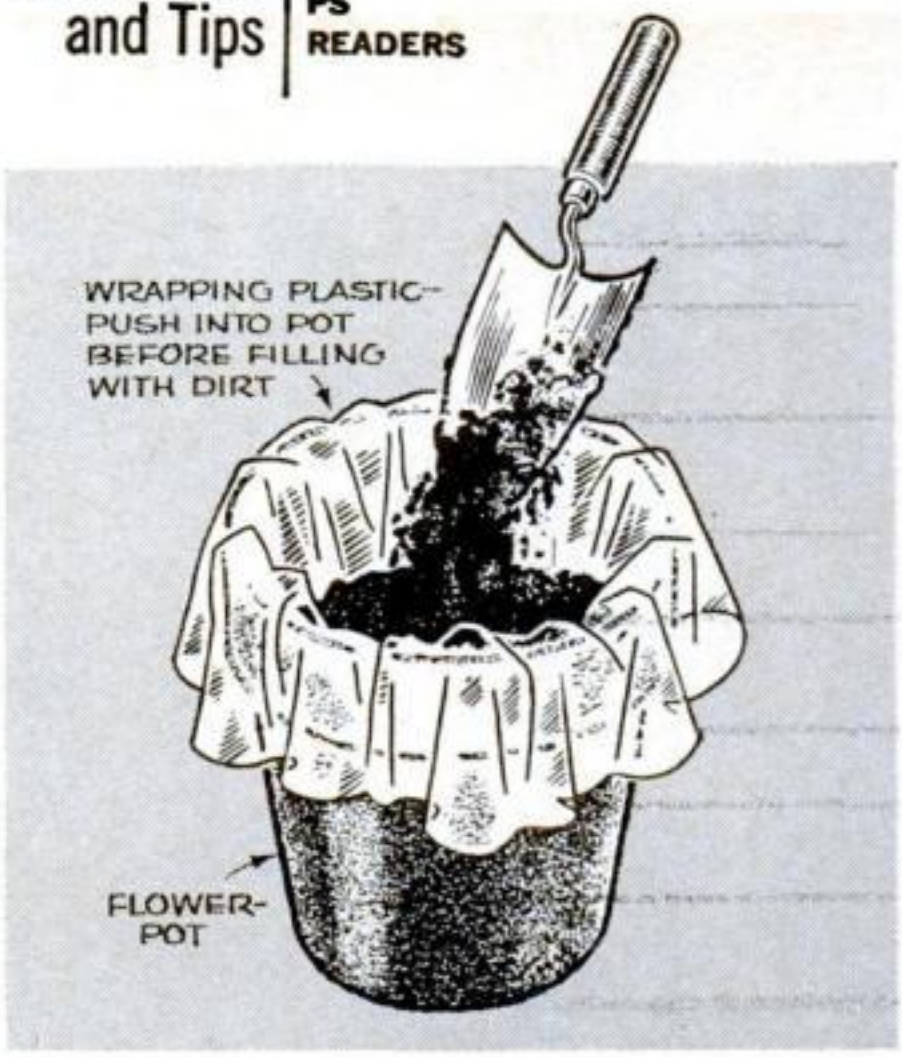
Short Cuts and Tips FROM PS READERS



Plastic liner makes transplanting easy

Line a flowerpot with a sheet of plastic before putting in soil. Punch holes for drainage. When the plant grows you'll have no trouble lifting it out for transplanting without disturbing or damaging the roots. *—Ken Murray, Colon, Mich.*

Magnifier holder is a "third hand"

Fine vernier scales are hard to read without a magnifying glass. But you need both hands to handle the caliper. So I made a holder for a dime-store magnifier. The stem was turned from aluminum to hold the glass at the correct distance. A slot milled near the stem end fits over the slide, and a brass thumbscrew locks the stem to the vernier. A screw holds the magnifier in place.—*H. J. Gerber, Menomonie, Wis.*

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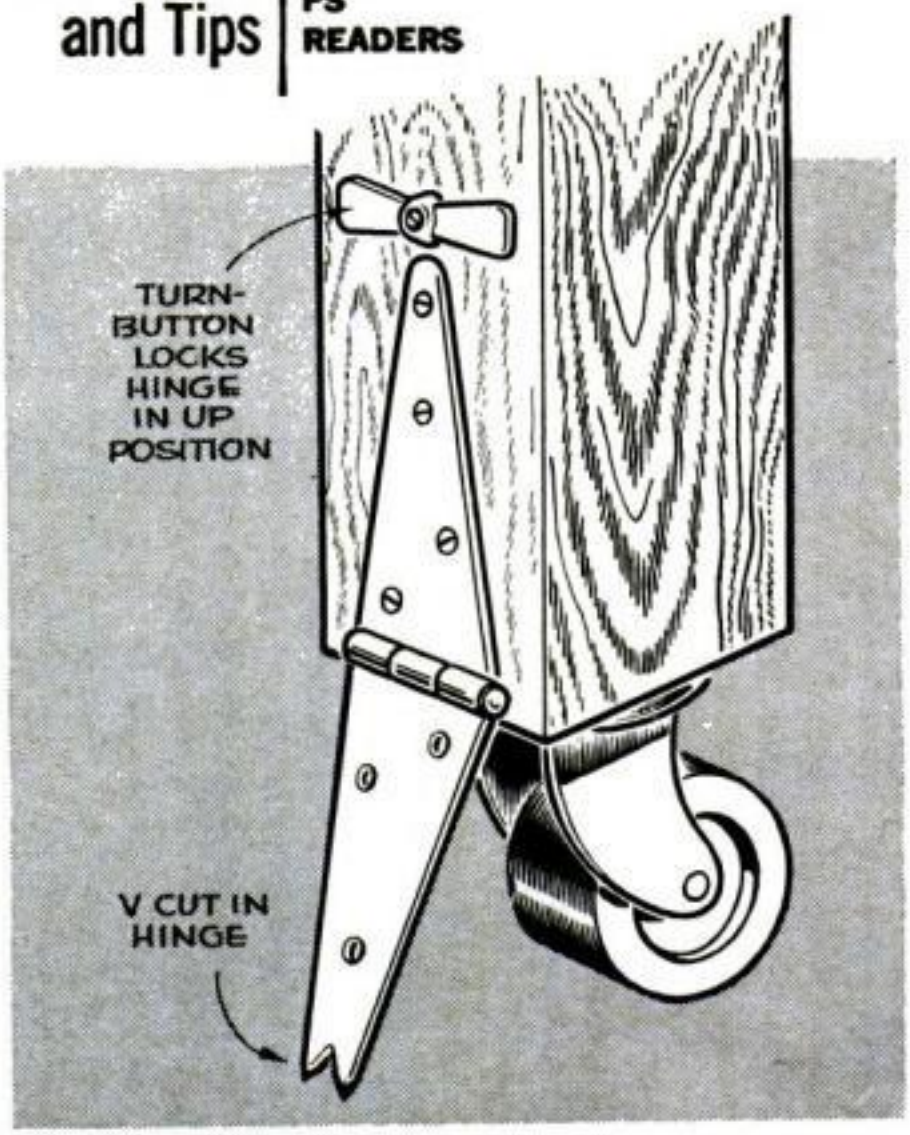
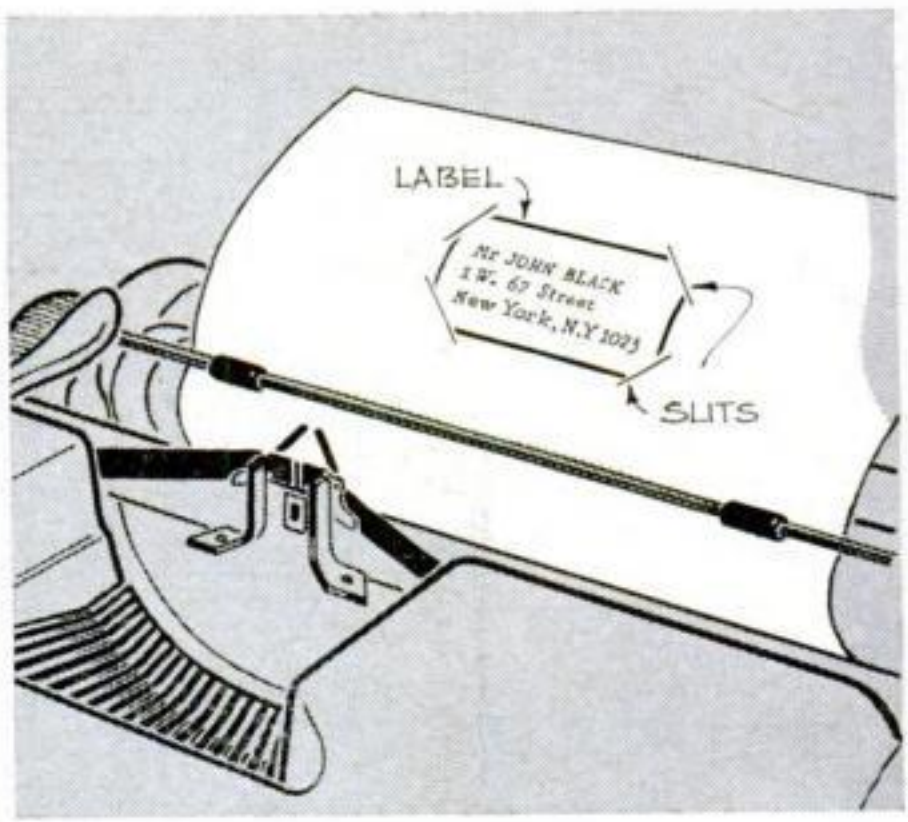


Hinge serves as brake for tool stand

A strap hinge can be adapted to serve as a brake for a tool stand on a shop floor. Cut a notch in one end to engage the floor. Locate the hinge so the end rests on the floor at 10 degrees from the vertical.—*Albert T. Pippi, Baltimore, Md.*



How to hold a label for typing

Ever want to type on small labels? Here's the way to do it: Cut four diagonal slits in a sheet of typing paper and mount the label as shown in the sketch. You can even type along the bottom edge without slippage.—*G. Czanstke, Jackson, Mich.*

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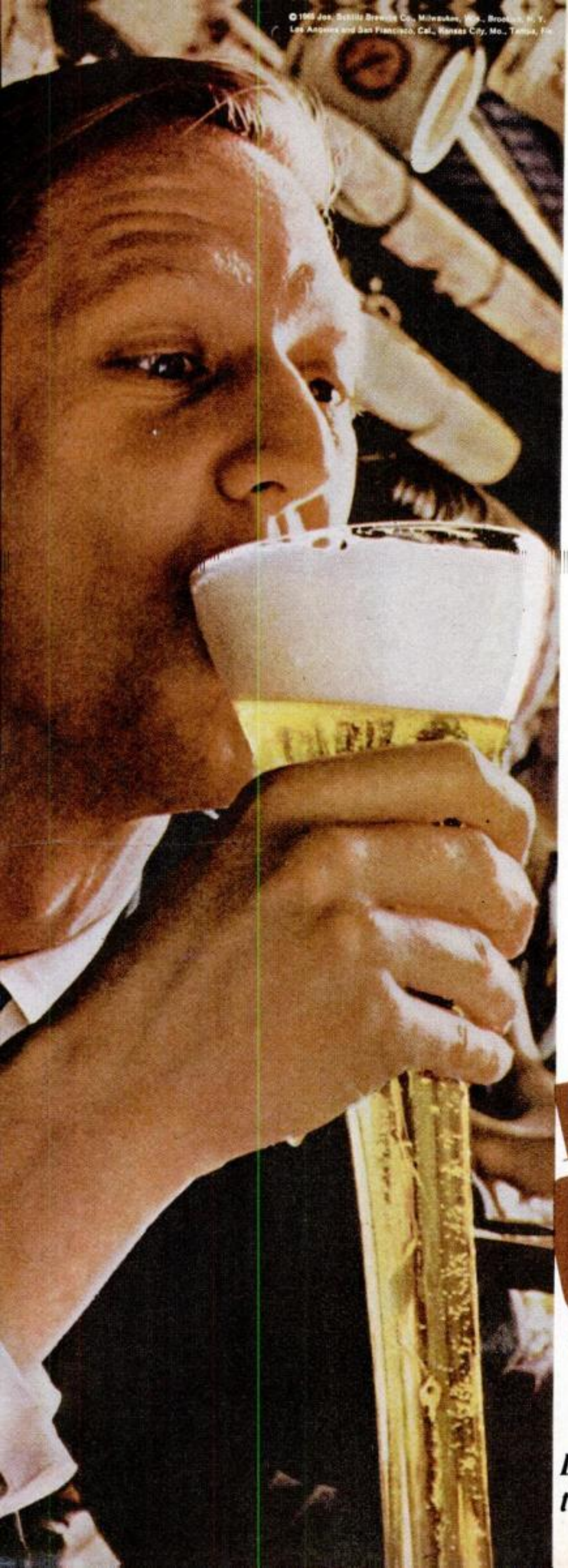

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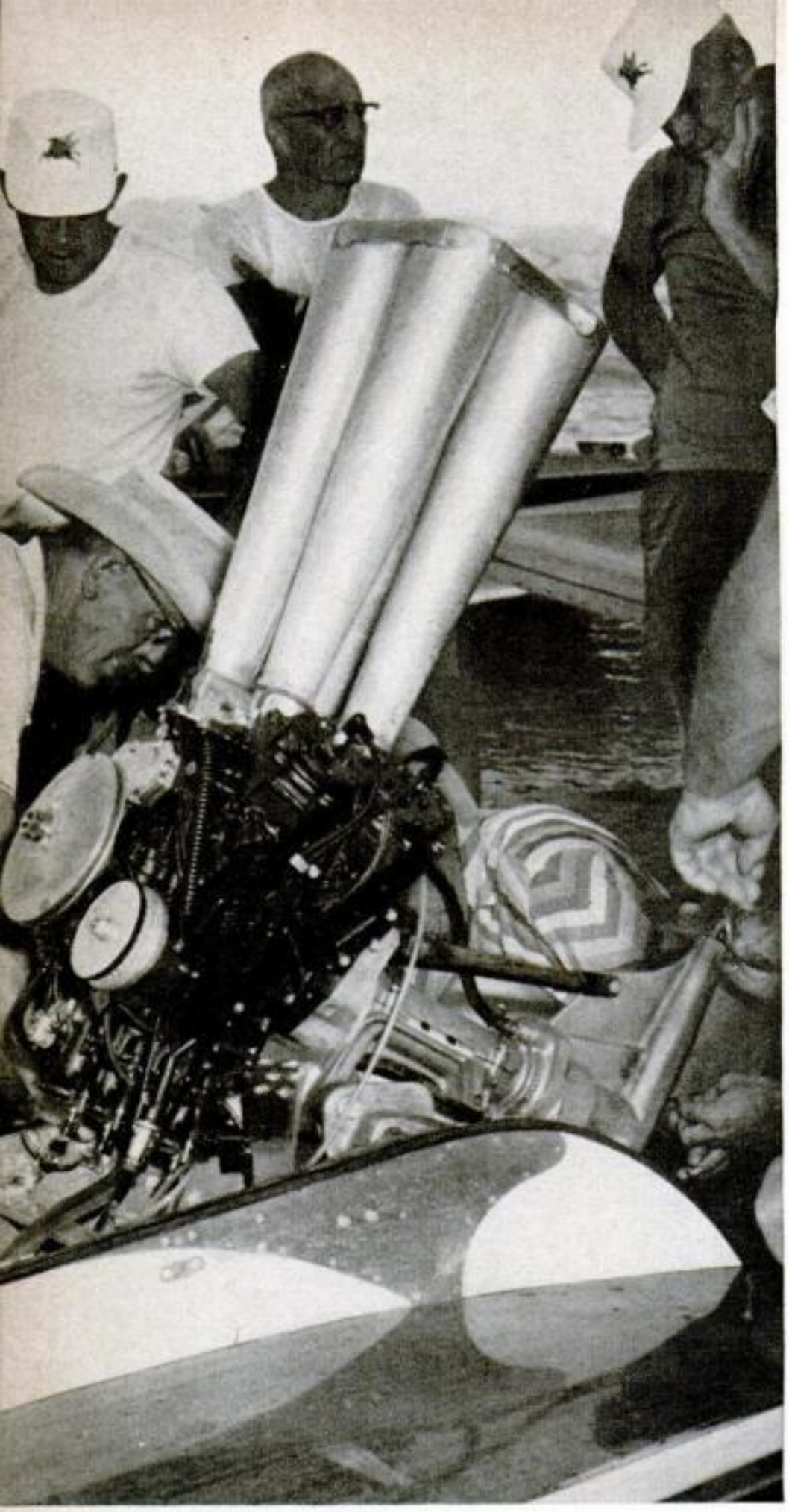

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The story of a man who determined not to let himself get worn out—and what he found he could do about it

Popular Science
REG U S PAT OFF Monthly

Billy Graham takes one-minute run on treadmill. Dr. Cureton, right, will check his recovery rate after exertion.

BILLY GRAHAM's Physical-Fitness Program Can Help YOU

By Curtis Mitchell
Associate Chairman, Physical Education Committee, National Council of YMCAs

THE tall blond man jogged easily around the field beside the Billy Graham Team headquarters in Atlanta, Ga. Perspiration flecked his forehead.

A passing car braked to a stop. Two men peered out. "Hey, that's the preacher, Billy Graham."

"What you reckon he's running for?"

What Billy Graham was running for had started

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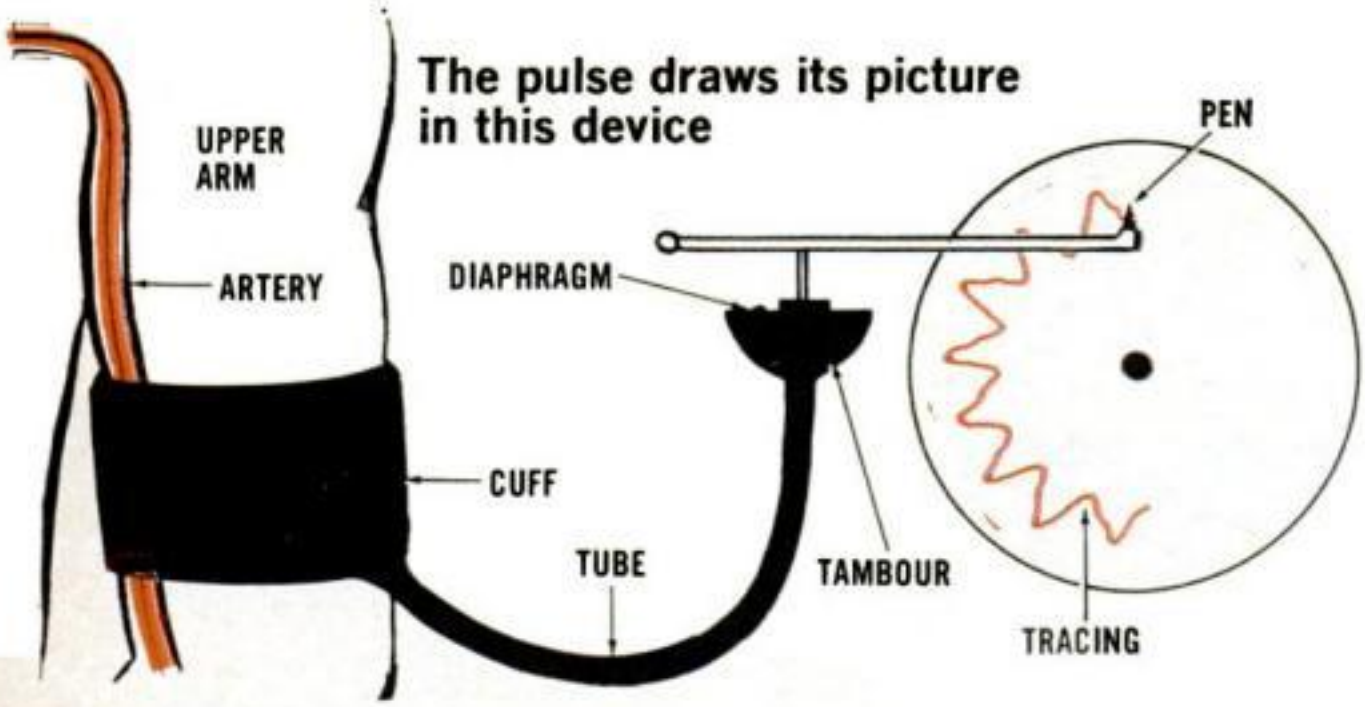
The pulse draws its picture in this device



Triangles traced by Heartometer are low and shapeless if heart is unfit, tall and broad if heart is fit. Pulse squeezes air from arm cuff through tube, to tambour with elastic diaphragm, actuating arm carrying pen. Tracing by pen on a revolving paper disk provides a graphic record of the heartbeat's strength.

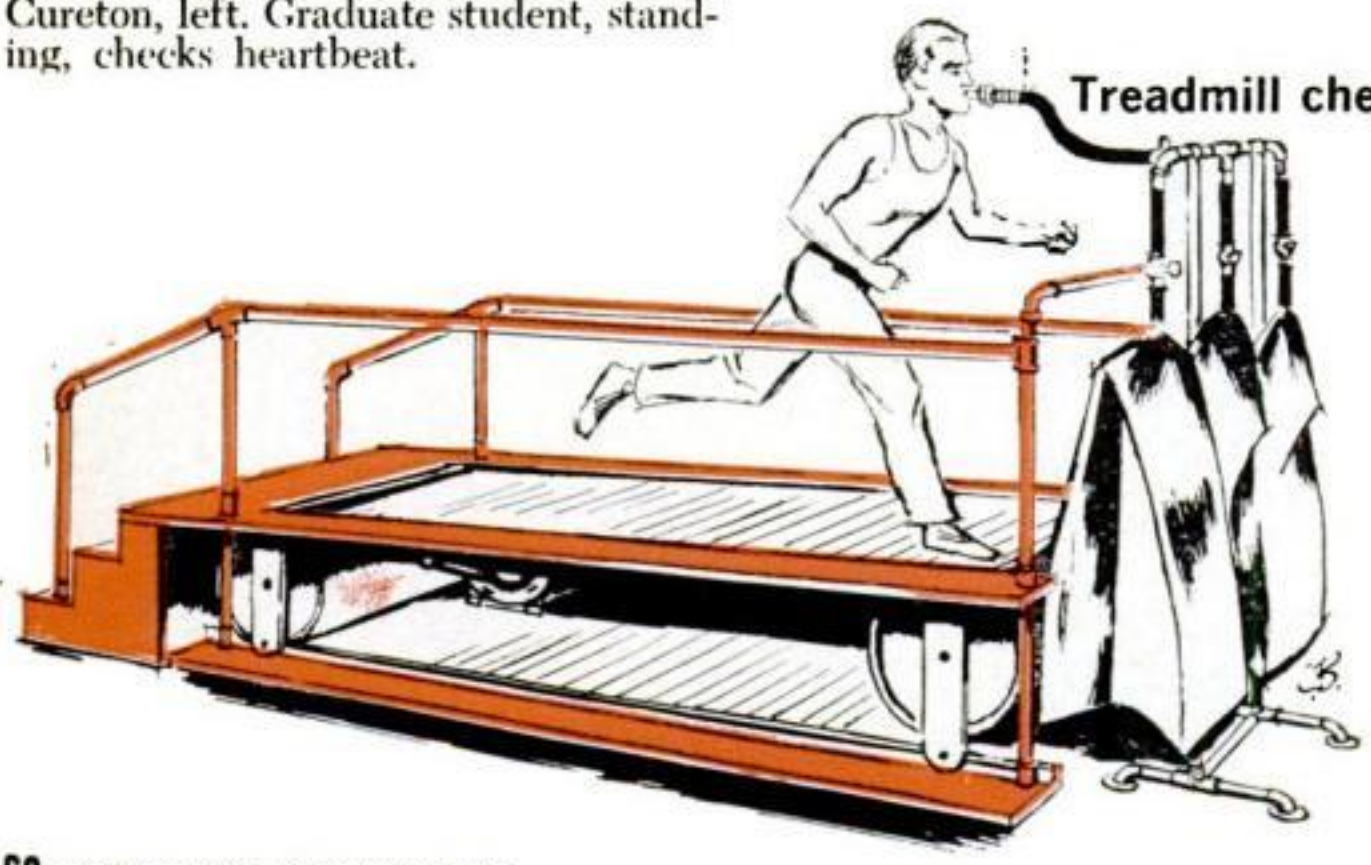
Billy Graham's blood pressure is studied at Physical Fitness Lab by Dr. Cureton, left. Graduate student, standing, checks heartbeat.

in 1964 in Boston, during one of his evangelical "crusades." He had begun to feel, each afternoon, an unusual amount of fatigue. A visit to the Mayo Brothers Clinic disclosed a touch of elevated blood pressure.

He was concerned because his program for the next 10 years would be unusually heavy. Crusades were planned for Hawaii, Copenhagen, Denver, Houston. In 1966 he hoped to cap his career with a great one in London. It would require a vast outpouring of human energy. He asked a friend, "What kind of exercise will keep me in shape?"

That query led to a meeting with Thomas Kirk Cureton, Ph.D., 63-year-old director of the Physical Fitness Laboratory of the University of Illinois. For 40 years Dr. Cureton has trained and tested adults. He has written 10 books and 300 articles about physical fitness.

Treadmill checks human "engine"



For revealing test, subject runs up slight incline of steadily moving, motor-driven treadmill belt. Air he exhales into mouthpiece is collected in large bags. Analysis of air then tells how efficiently his human "engine" is burning its fuel and getting rid of "cinders"—the process that medical men call metabolism.

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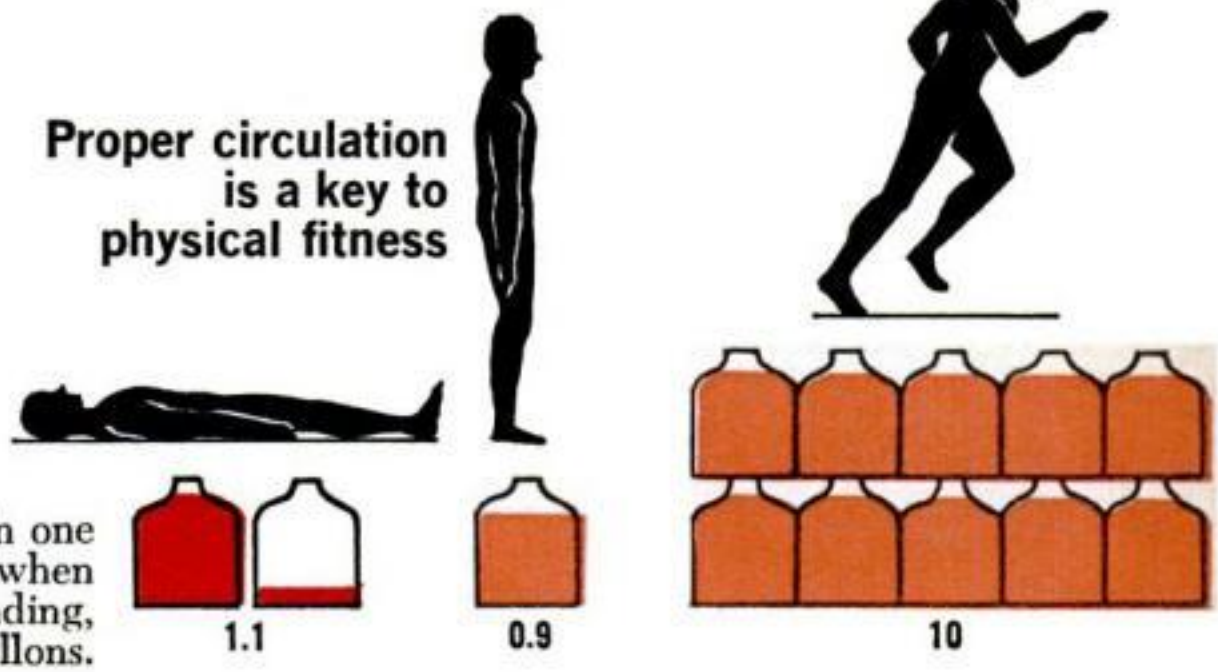
Headward "kick," as blood from heart pulse hits hairpin turn in aorta of reclining human body, can be measured by this sensitive recording device called a ballistocardiograph.



How much blood your heart pumps in one minute ranges widely, as shown: when you're lying down, 1.1 gallons; standing, 0.9 gallon; running, as much as 10 gallons.

A consultant to the President's Council on Physical Fitness and to hundreds of YMCAs, Dr. Cureton was holding a clinic at the nearby Cambridge YMCA during the final week of Graham's Boston program. The evangelist went to see him.

The danger signals. After tests of Graham's flexibility, muscular power, and cardiac condition, Cureton checked the record—and disliked what he saw. It could have been that, probably, of most modern American men who sit too much and relax too little. It showed too much tension, too much fat, and a cardiovascular system flying several danger signals.

"Unless you change some things, you may be headed for trouble," Cureton warned. "I'll give you some exercises to get you started."

That meeting marked the beginning of Billy Graham's fitness program, to provide the endurance he needed to carry on his work. The first step was to *understand about fitness.*

The body's circulatory system of arteries and veins, through which blood flows, is like a car's radiator, in that the blood serves as a coolant. But this human system also feeds the body, distributing oxygen and nutrients. Half of its 60,000 miles of piping is a delivery service; the rest is a waste-collecting system. When it begins to fail, man begins to age.

We age prematurely. Because of our sedentary ways, our young men now enter middle age in their 26th year. Dr. Hardin Jones discovered this at the University of California when he measured the circulation of 18-, 25-, and 35-year-olds. At 18, his subjects were in their prime, averaging a blood flow of 25 cc. per liter of muscle. At 25, their flow had decreased by 40 percent—and at 35, by 60 percent.

CONTINUED

Fitness	18 steps a minute	24 steps a minute	30 steps a minute
Above average	151 or less	164 or less	184 or less
Average	160 to 178	175 to 195	195 to 217
Below average	188 to 206	205 to 225	227 to 249
Poor	Over 216	235 or more	260 or over

Here is a do-it-yourself test of fitness

Step up on a kitchen chair and down again, repeatedly, for one minute. Count your pulse for two minutes afterward. Compare the total count with the figures in the table above, for an approximation of your cardiovascular fitness. Before you try it, some notes: If you feel distress at any time, stop. After a minute's stepping you may take 10 seconds to sit down, find your pulse at your wrist, and start counting. If the count exceeds 27 in the first 10 seconds, quit counting; your heart is working at maximum effort and a further count will not reflect your condition accurately.

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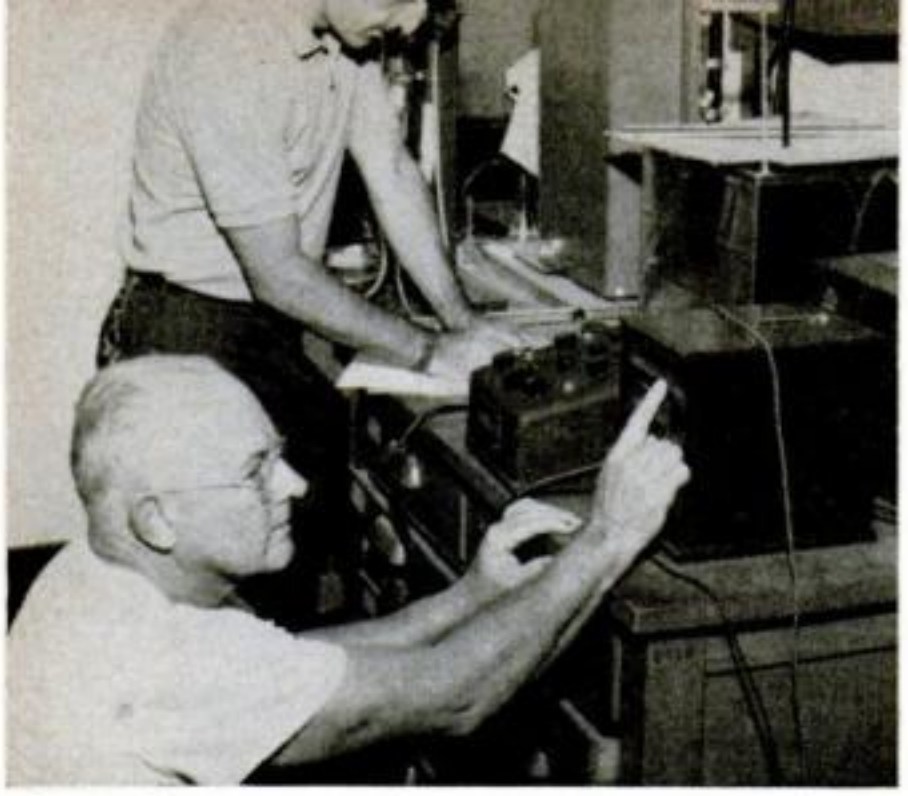

Physical Fitness Lab at University of Illinois offers more than 100 techniques and instruments for tests. Here Dr. Cureton, foreground, and assistant examine findings as to Graham.

In his 40s, Billy Graham had premature, reduced blood flow.

A physical educator knows what to do for that, just as a good mechanic knows what to do for a car that has been driven slowly around town until carbon has built up in the cylinders. The mechanic takes the car for a high-speed run in the country and brings it home nicely cleaned out. A fouled-up man needs a workout, too, but with a big difference. He is flesh and not metal. His breaking-in process must be more gentle.

In planning a gradual approach, Cureton uses the terms: low gear, medium gear, high gear. Last fall he introduced Graham to low gear.

"We found him a pretty tense individual," he told me. "When I had him run in place at Cambridge, and then took his blood pressure, it shot right up. That meant his blood vessels were very tight. This has nothing to do with disease. It's overactivity in the brain, which transfers to the body, and may show up in the heart. Well, our work shows that a moderate exercise session, continued long enough to build up good body heat, will break this tension quite a bit. With Dr. Graham, the critical thing was to break the tension."

Low gear. So Graham had a choice. He could exercise, or he could let himself go and deteriorate. Back home in North Carolina, he began to climb the trails around his mountaintop house. Cureton had advised a long low-gear effort:

"Walk a mile a day, at first. After the walk, take stretching, bending, and a few strength exercises such as sit-ups and leg-raisings. Keep at it 15 to 20 minutes. After a week, increase your walk to two miles. Add more calisthenics, such as swinging the arms hard, twisting the shoulders, bending the trunk, breathing deep and strengthening the chest muscles, working knee and ankle joints. At the end of the session, run in place for one minute, 180 steps to the minute. After two weeks, increase the speed of the walk or add another mile. If a pool is available, work up to 10 minutes of continuous swimming. Finish with calisthenics. After two months or more, if the body is tolerating the daily workouts, you can begin to jog. At first, jog a block and walk a block, or enough to rest. Repeat this five or six times . . ."

Within a few weeks, Graham noticed a change. "All my life I've had to rest in the afternoon," he told associates. "Now I can sail through a day's work without any fatigue. And I seem to need less sleep."

What was happening? His circulation was improving. His obsolescing capillaries were beginning to do their job.

The vital capillary system. Everyone possesses capillaries by the billions. They penetrate every part of the muscular and nerve systems. Think of the heart as the roots of a tall tree. Rising from it like a trunk is the large blood vessel called the aorta, which splits into branches and then into lesser branches and finally into tiny twigs. These twigs on your arterial tree are your capillaries.

Capillaries open and close, controlled principally by an automatic system of nerves that equip every blood vessel with its own stop-and-go spigot. Use your body vigorously and nerve tendrils open those spigots, dilate your capillaries, and fill them with blood. Only then can the blood deliver to them the oxygen and nutrients it carries.

[*Continued on page 202*]

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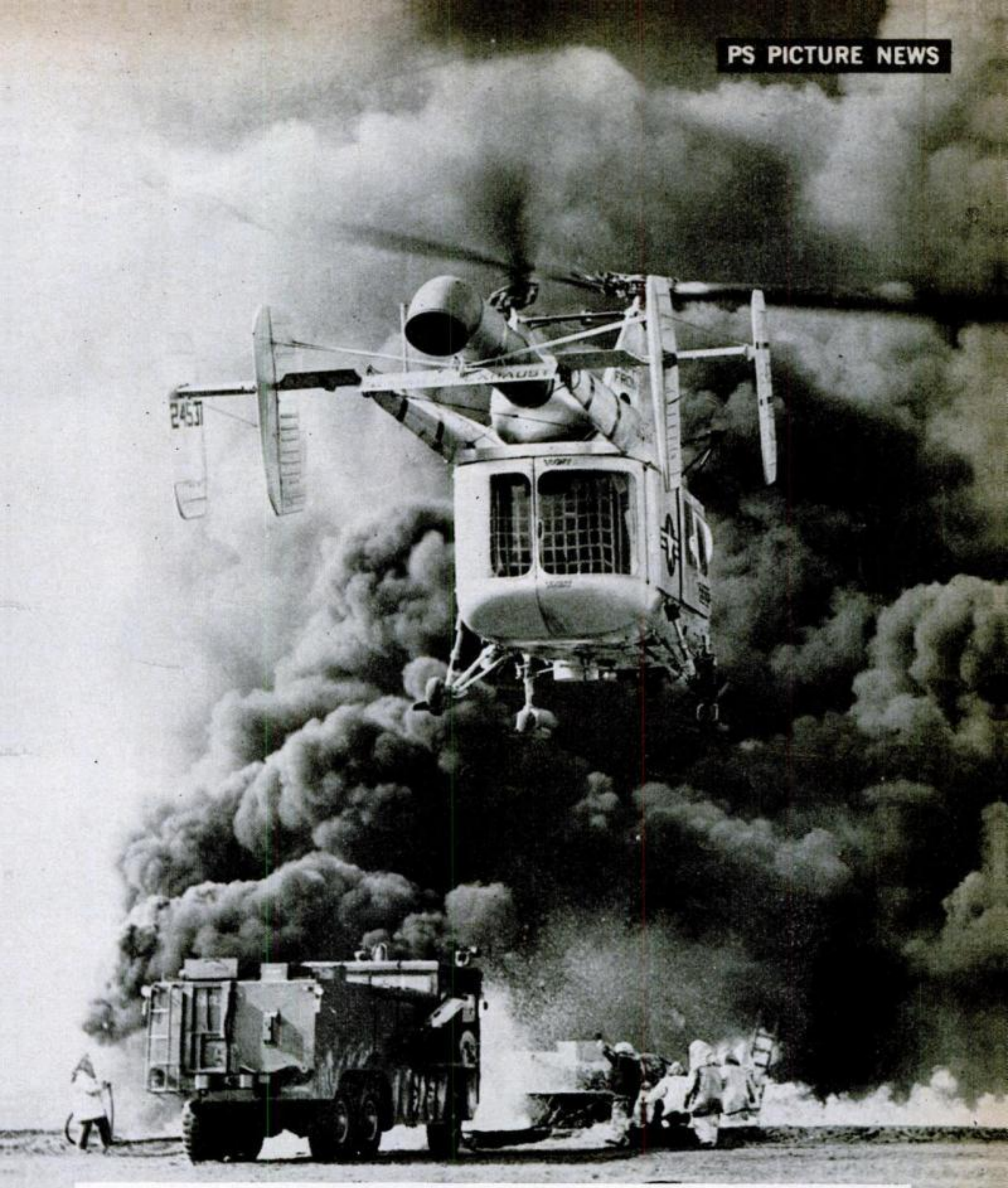
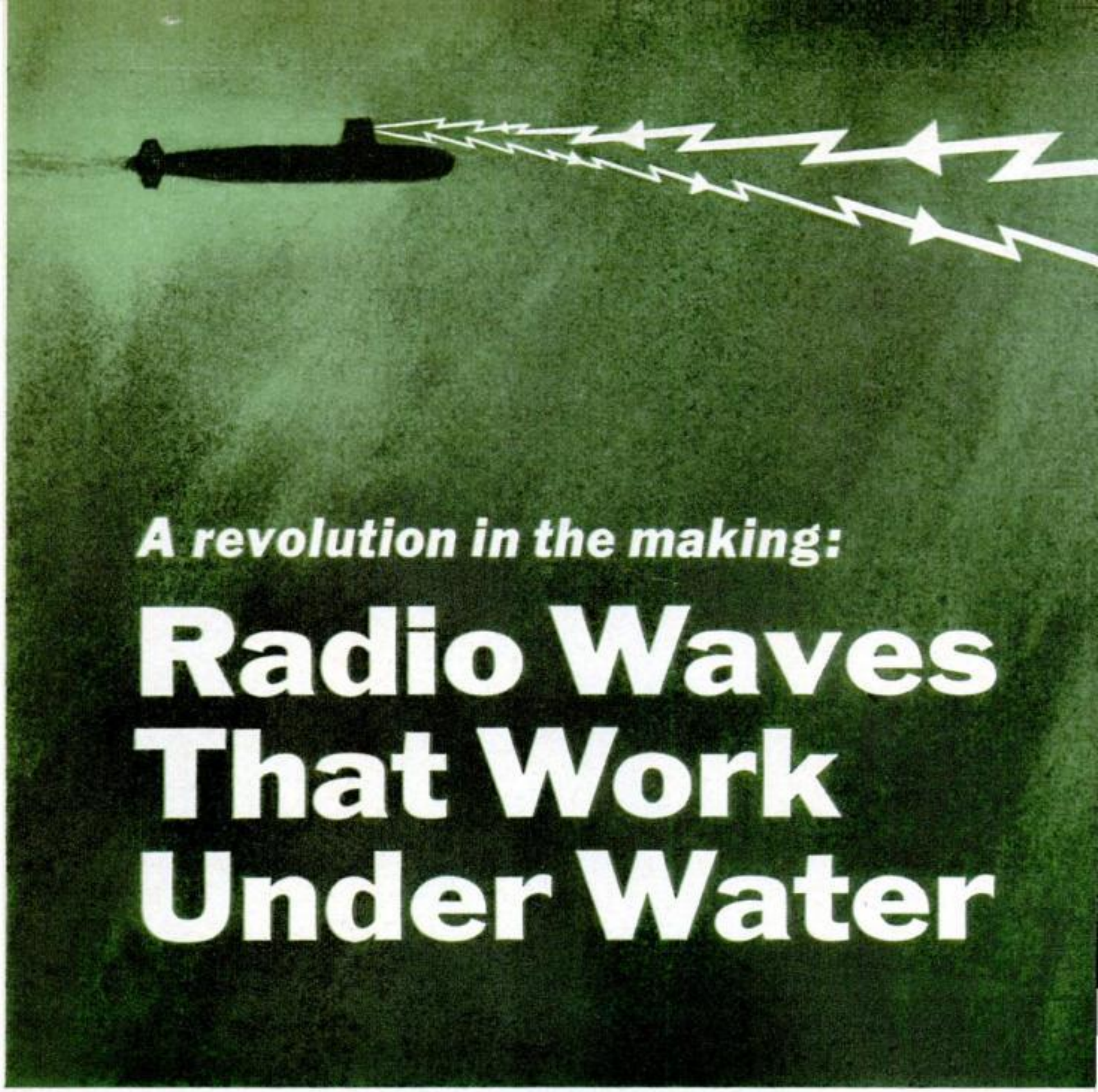


Copter beats path through fire for plane-crash rescuers

This dramatic shot of a helicopter making a path for rescue workers by beating down flames with the downdraft from its rotor was chosen by German and American editors as picture of the year of the U.S. Air Force in Europe. Photo of the Kaman HH-43B Huskie was taken for the Frankfurt Deutsche Presse-Agentur during exercises at Laon, France.



A revolution in the making:

Radio Waves That Work Under Water

Talk to subs at the bottom of the sea? Send underwater TV? Maybe—with "hydronic" waves

By Ken Warner

Exclusive story, copyright © 1965
by POPULAR SCIENCE MONTHLY

HOW do you make a radio wave travel under water? Scientists have been searching for the answer almost from the time Marconi sent his first wireless message. Now an electronic experimenter, Wallace L. Minto of Sarasota, Fla., may have accidentally found the answer.

True underwater radio would revolu-

 CONTINUED

Transmitting antenna used for the demonstration consisted of two metal plates (probably of monel) bolted to a simple wood frame, as below.

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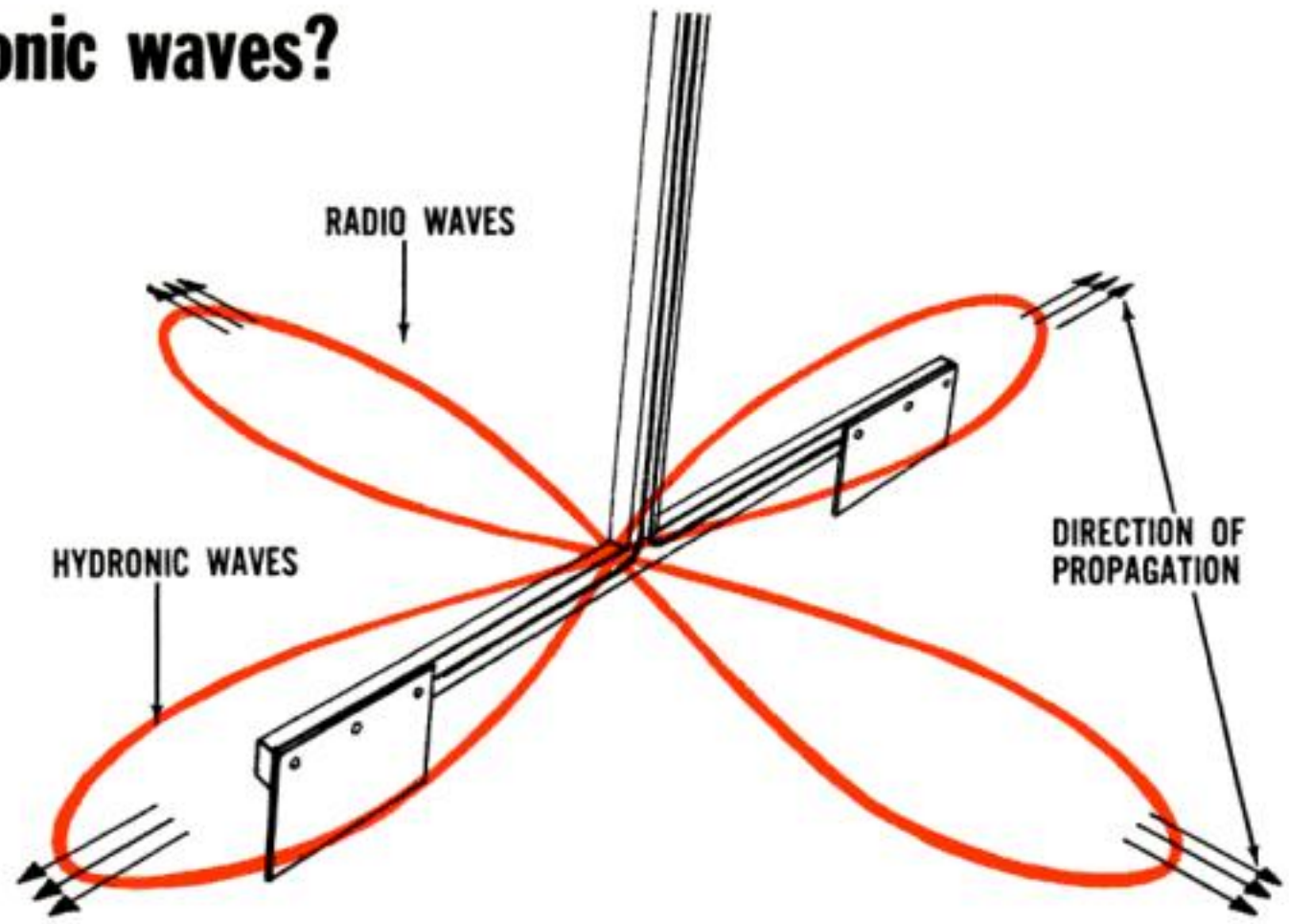
W. L. Minto, the system's developer, broadcasts under water via hydronic waves. The small case on the pier houses the transmitter circuits.

Skin divers, equipped with portable hydronic gear, take to the water. Submerged, they received and obeyed simple commands.

What are hydronic waves?



Hydronic radiation is similar to conventional radio in that it is generated by oscillating electric currents. Both are emitted and received through antennas, and can be amplitude-modulated (AM) or frequency-modulated (FM). The waves apparently obey the inverse-square law: At a range of 20 feet they are ¼ as strong as at 10 feet. Hydronic waves differ from conventional radio in that the waves are easily propagated through water, not through the air or a vacuum.

Tests on similar dipole antennas (one in water, and one in air) have shown that the two kinds of waves are emitted at right angles to each other. Conventional radio waves are emitted perpendicular to the antenna's axis; hydronic waves parallel to the axis.

Antenna requirements for hydronic waves are different: The length of the antenna seems to have no effect; area, cross section, and material of construction are the most important factors.

Tests have shown that hydronic waves are immune to interference from above-water atmospheric conditions (thunderstorms) and underwater sonic disturbances (such as power boats). Hydronic radio will work in fresh water just as readily as in salt water.

tionize much of our present communications: Telephone conversations and TV shows could be transmitted between continents as easily as microwave links carry them between cities; radio beacons would let submarines navigate while submerged with the ease of surface ships; and underwater radar could detect unfriendly subs as effectively as our defense radar spots unfriendly planes.

I recently joined a team of military and scientific observers in Sarasota to witness the first demonstration of Minto's experimental underwater radio system. We watched and listened as he chatted with co-workers by broadcasting between submerged transmitting and receiving antennas, and gave orders to skin divers equipped with small transmitter-receiver units.

Even though the maximum underwater distance covered in the demonstration was only about 100 feet, we were told about one test that covered 30 miles. Minto believes his system uses a new kind of radio waves—he calls them hydronic, short for hydroelectronic. Conventional radio waves are rapidly absorbed by water.

The U.S. Navy uses the most powerful transmitter in the world to beam low-frequency conventional radio signals to Polaris submarines, yet it can't reach them if they are more than 30 feet deep.

Minto first observed hydronic waves while developing the circuitry for a sonic fish-finder. His gear picked up a lot of unexplainable static. Tests showed that the static was really radio signals traveling through the water. They were being generated by nearby fish. Minto shelved the fish-finder and went to work on hydronic waves.

What did the scientists think? Some were skeptical. Most marveled at the far-reaching implications of Minto's discovery: Biologists could use radio to study fish behavior, and fishermen could track down huge schools of fish by zeroing in on the signals they emit.

All agreed, though, that hydronic waves deserve a lot of intensive research. ■ ■

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Wears his radio on his hat

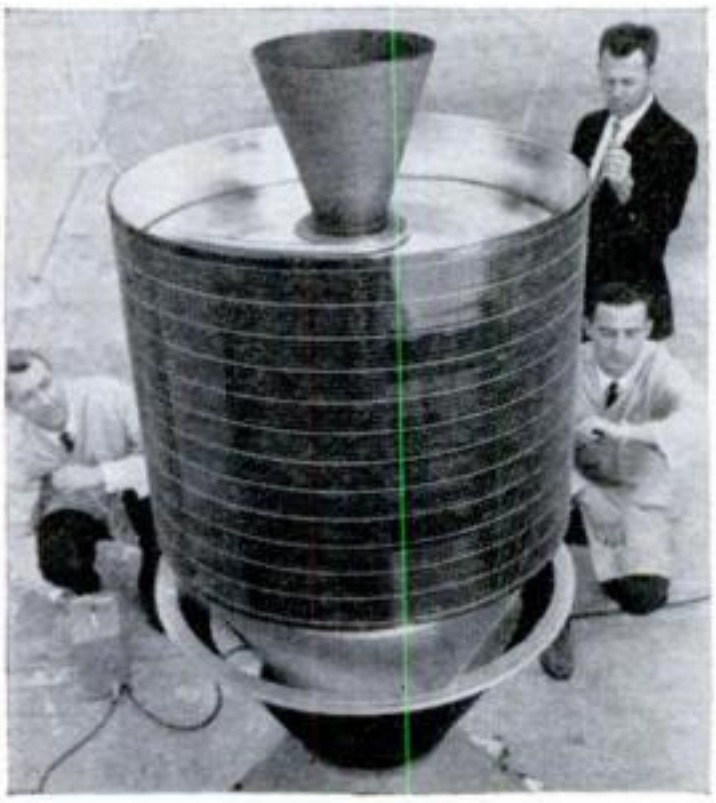
A tiny seven-transistor radio fits snugly in the stretch pocket built into the side of this new hat. To keep from annoying others in the street, there's a wire to a plug-in earphone running from hat to ear.

The radio operates on a penlight battery. The hat is made for Dobbs, Cavanagh, and Knox.

Early Bird readied for orbit

First satellite built for private ownership, the Early Bird will go into orbit 22,300 miles in space, linking America and Europe with 240 two-way telephone channels.

An improved Syncom, it's owned by the 40-nation Communications Satellite Corp. Below, Hughes engineers test it on a spinner for efficiency of its sun sensors. ➧



"Aquambulance" ladles up sea victims

This pivoting safety rig at the bow of a square-prowed boat dips under a floating stretcher holding a drowned or injured person, lifts the stretcher out of the water, and speeds the victim to shore.

The stretcher, buoyed up by plastic foam, is first maneuvered under the victim; water wings on the sides inflate to hold him in place. Aquambulance, built of aluminum by Water Safety and Utility Research, Nashota, Wis., can haul a 250-pound man.

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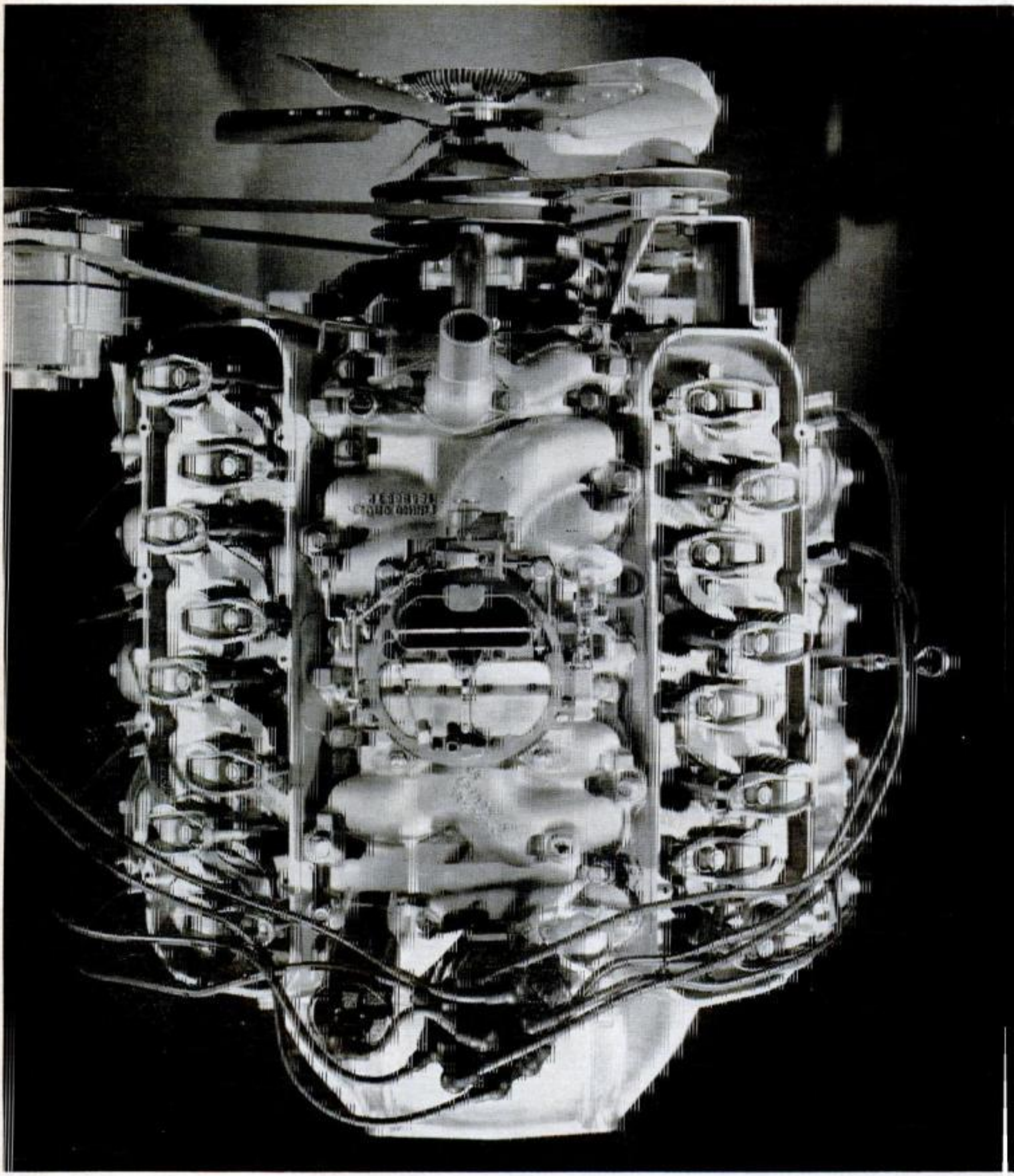
The '65½ Cars

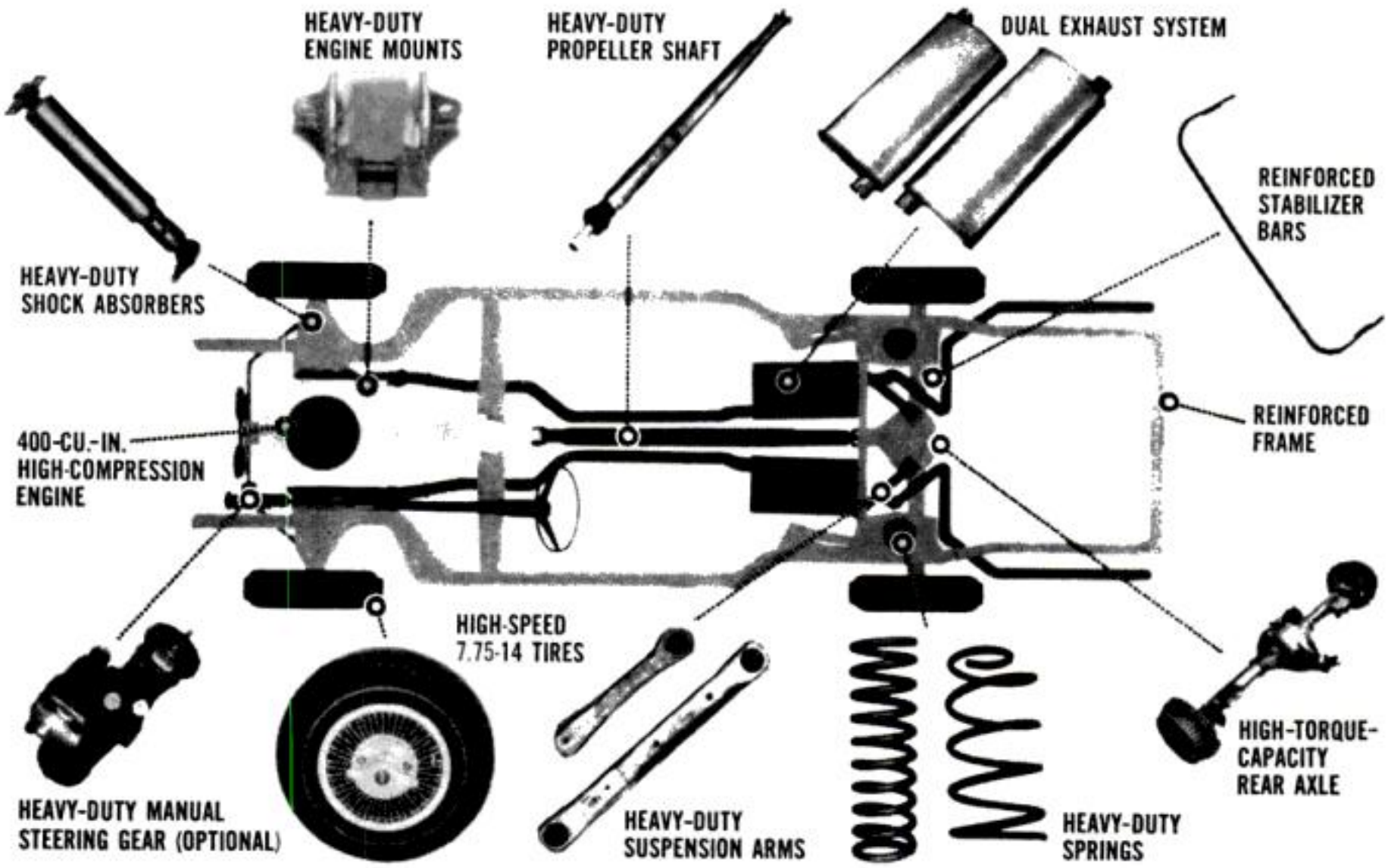
Hotter Engines



Urheberrechtlich geschütztes Material

A brand-new Chevrolet V-8 engine, high-performance models from Buick and Oldsmobile, and a genuine sports Mustang set the pace in springtime introductions

and Tougher Suspensions



Oldsmobile F-85-based 4-4-2 chassis contains special components to improve not only performance but safety and durability. There is a choice of manual and automatic transmissions, and power steering is standard while a heavy-duty manual steering gear is optional. Also available are fade-free metallic brake linings. The 4-4-2 comes as a hardtop or convertible.

By Jan P. Norbye

MIDSEASON new-car announcements have become highly fashionable since Ford first brought out semiannual models three years ago. Now we have a number of 1965½ cars sandwiched between the 65s and 66s, all with a sporty accent:

- Chevrolet has brought out a new high-performance 396-cu.-in. V-8 engine.
- Oldsmobile offers a jazzy Cutlass-based model called the 4-4-2.
- Rambler has got on the Mustang gravy train with a stylish car they've named the Marlin.
- Buick has introduced Gran Sport versions of both the Riviera and the Skylark.
- Carroll Shelby offers the Mustang GT 350 (a genuine sports car).

In addition, Ford has developed a 427-cu.-in. V-8 with overhead camshafts, which still awaits a production-car application. And Dodge is preparing its answer to the Barracuda—a high-performance Dart-based fastback, which

◀ **Chevrolet Turbo-Jet 396 engine** has rocker arms mounted on staggered ball studs. The valve gear was developed for maximum gas-flow efficiency, not for mechanical simplicity. The exhaust ports are short and straight, and the intake valves are bent back to allow a straight gas-flow path to the combustion chamber.

CONTINUED

Urheberrechtlich geschütztes Material

Do motorists want higher performance? Look at the success of

may possibly be equipped with the Hemi-Hummer 426-cu.-in. engine.

The trend towards a sporty flavor in American cars, sparked by the Corvette and the Thunderbird over a decade ago, has gained tremendous momentum in recent times, thanks to such cars as Pontiac's GTO and Ford's Mustang. Chrysler found it necessary to back up the sporty looks of the Barracuda with a power package and heavy-duty suspension, and Rambler will probably have to do the same with the sleek, fastback Marlin.

Things to come. If the 1965½ announcements are anything to go by, the 1966 models will offer more high-performance options than have ever been available: heavy-duty springs and shock absorbers, four-speed floor shifts with close-ratio transmissions, high-speed tires, and fade-free brakes.

The most significant of the 1965½ arrivals is the 396-cu.-in. Chevrolet V-8. The design is conventional in its main features, with a single camshaft and pushrod-operated overhead valves. But the detail work on gas flow and cooling is impressive, and its thermal efficiency is very high.

In designing the Turbo-Jet 396, the Chevrolet engineers started with the cylinder head, just as racing engineers have done for half a century. Straight intake and exhaust ports with minimal obstructions were given priority over valve-gear simplicity. The ports consequently took up some of the space normally used for the pushrods, but Chevrolet angled the pushrods around the ports and devised a new rocker-arm geometry that looks totally unbalanced but keeps all reciprocating parts of the valve gear in proper alignment. The exhaust valves are inclined a normal nine degrees from the cylinder center line, but the intake valves are canted back about 26 degrees, giving a straighter gas flow path.

The "street" version of the 396 has hydraulic valve lifters and a 10.25:1 compression ratio. It puts out 325 hp. at 4,800 r.p.m., while the high-performance version with 425 hp. has solid lifters and a compression ratio of 11:1. Initially the 396 is available only on the full-size Chevrolet and on the Corvette, but we can expect a Chevelle version soon. The 396 Impala will also be available with Turbo-HydraMatic transmission instead of the old Powerglide.

The 400-cu.-in. engine used in the Skylark Gran Sport and the Oldsmobile 4-4-2 is not related to Chevrolet's 396

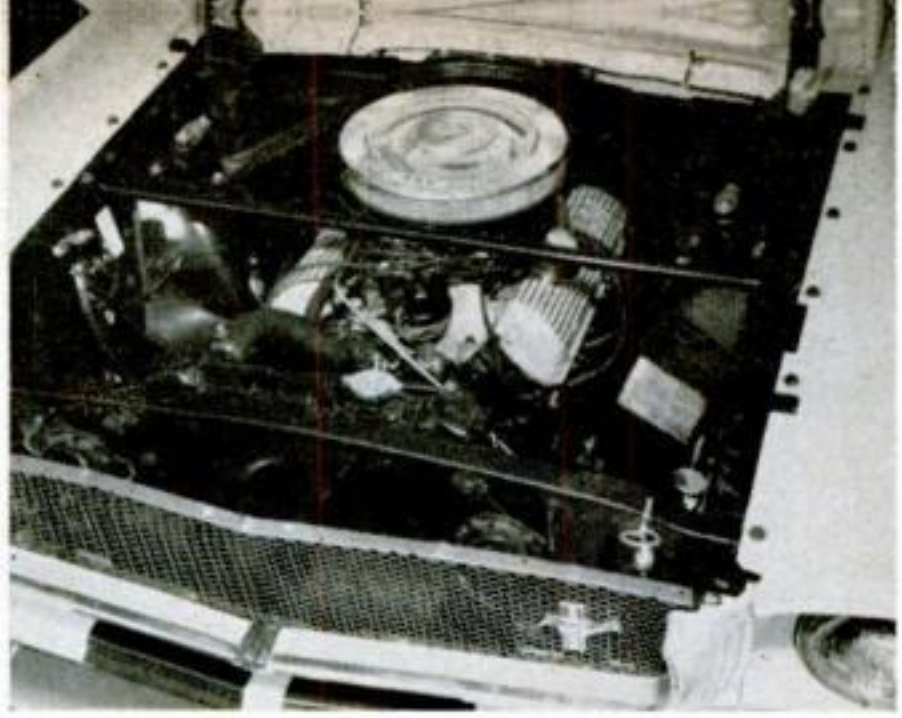
Buick Riviera Gran Sport has shorter, stiffer springs than standard model and a new and more responsive steering gear. Engine is a 360-hp., 425-cu.-in. V-8 coupled to a Super Turbine 400 automatic transmission with recalibrated shift points; these make possible higher r.p.m. in Low and Intermediate. The car also has a Positraction differential as standard equipment.

Urheberrechtlich geschütztes Material

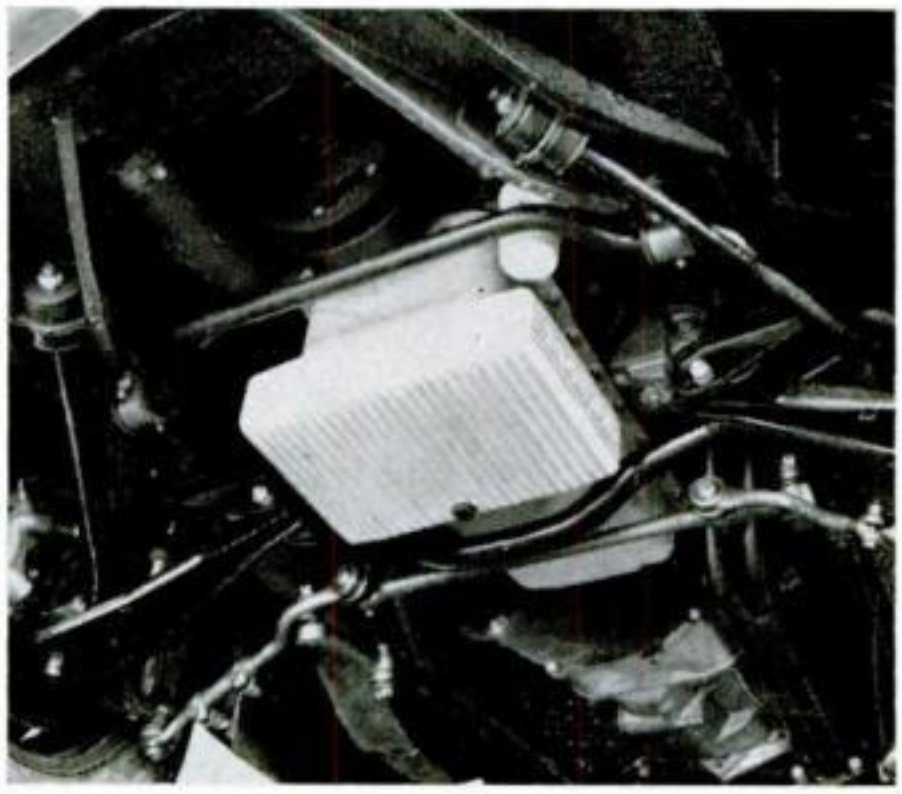
the Mustang and Tempest GTO

but is derived from Oldsmobile's new 425-cu.-in. V-8. The only differences are a smaller cylinder bore, smaller pistons, special exhaust manifolds, and a heavy-duty cooling system. While the highest-powered GTO boasts 360 hp., the 4-4-2 claims 345, and the Buick 325. Both the newcomers are quieter than the Tempest GTO while providing almost equal acceleration. However, the chassis modifications do not quite match the performance, although the handling characteristics of both the 4-4-2 and the Gran Sport are far superior to the basic F-85 and Special. However, we feel that all these cars ought to have disk brakes, which Ford made optional on the 1965 Mustangs and Rambler offers on the Classics and Ambassadors.

The number of limited-production models is steadily increasing. Chevrolet has its Corvette, Buick its Riviera. Olds will soon present its front-drive Holiday [see PS, April], and Pontiac is expected to bring out a car that will give competition to both the Corvette and the Mustang. And if you think Cadillac, Lincoln-Mercury, and Chrysler are going to meet this influx of sports models with indifference or passivity, you're in for some surprises when the 1966 models bow in next September! ■■



Mustang GT 350 is a development by Shelby American—not Ford Motor Co. The engine is the famous 289-cu.-in. V-8 that formed the basis for Ford's Indianapolis engine in 1963.



A special camshaft, larger carburetor, and higher compression ratio are on the GT 350. It also has a large-capacity light-alloy oil pan. Power output is approximately 350 hp.

Oldsmobile 4-4-2 has a pleasant cockpit, except for positioning of the tachometer (on center console, below radio). If the car is moving, it is dangerous to look for it or at it.

Interior of Mustang GT 350 sports a wood-rim steering wheel and sensibly mounted instruments, such as the tachometer and temperature gauge inset in the hooded dashboard padding.

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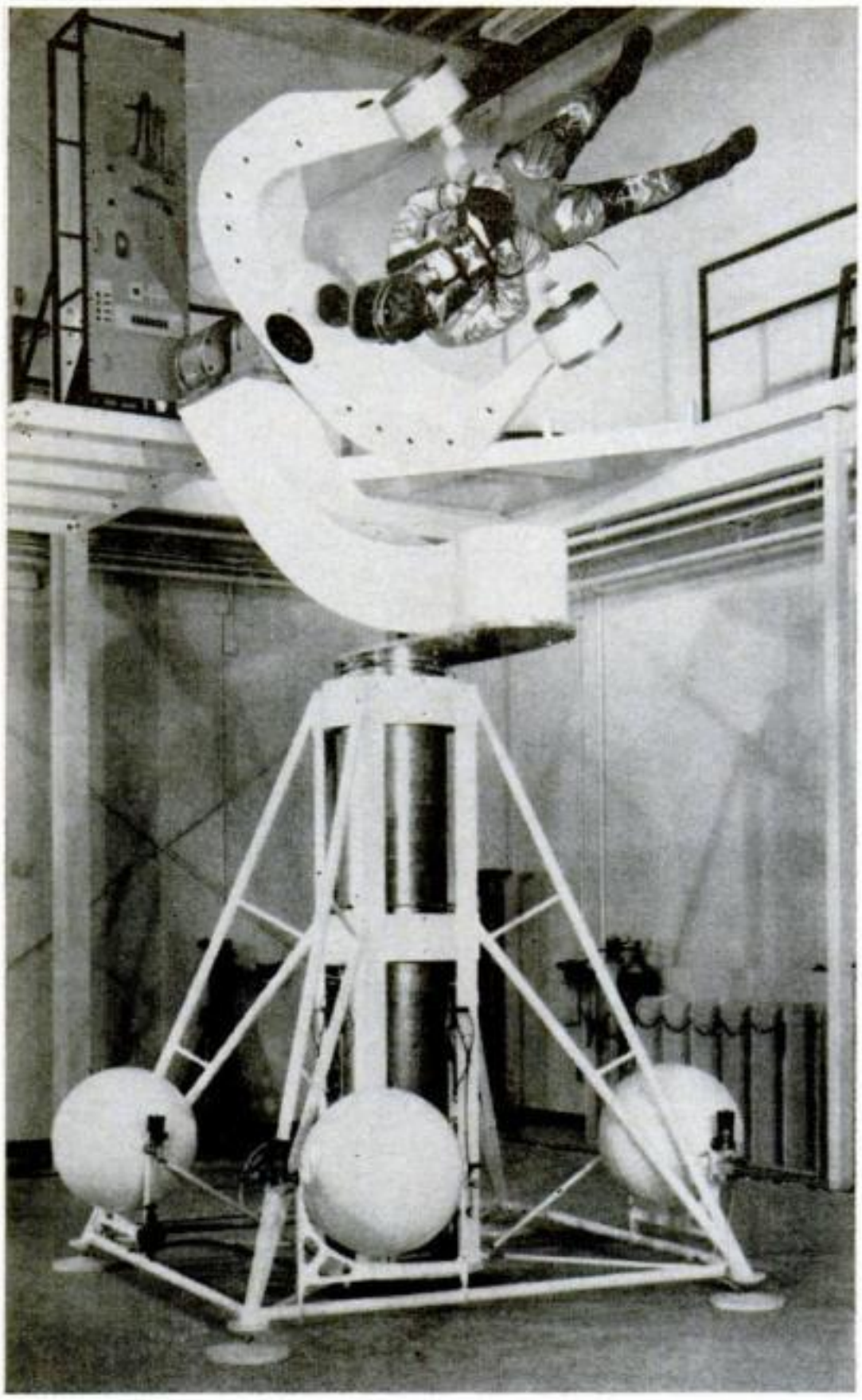

Pinwheel takes astronaut for a ride in "space"

Horizontal and vertical posts on the machine at left work in frictionless air bearings to simulate weightlessness. They spin the man strapped in its arms in a direction opposite to that in which he applies the slightest force.

First problem was for him to reach the mock control panel at upper left. The feet of the Convair device move on air cushions.

Shoes used as wagon brake

When the brake shoes wore out on a junkman's wagon in Birmingham, England, he replaced them with an old pair of his own shoes—and not just for kicks. The leather soles tied to the blocks check wheel movement, serving as brakes.

At full 43-inch height, 28-foot-wide gate closes off driveway.

At press of button, it begins

Pushbutton gate disappears into underground channel

Hydraulic fluid in the gateposts, instead of hinges, opens and closes this West German gate. Operated by pushbuttons in the gatehouse and on either post, the gate disappears into a channel sunk at gate height in the ground. Cars pass over the top at driveway level without a bump.

The gate is suspended by pistons in a

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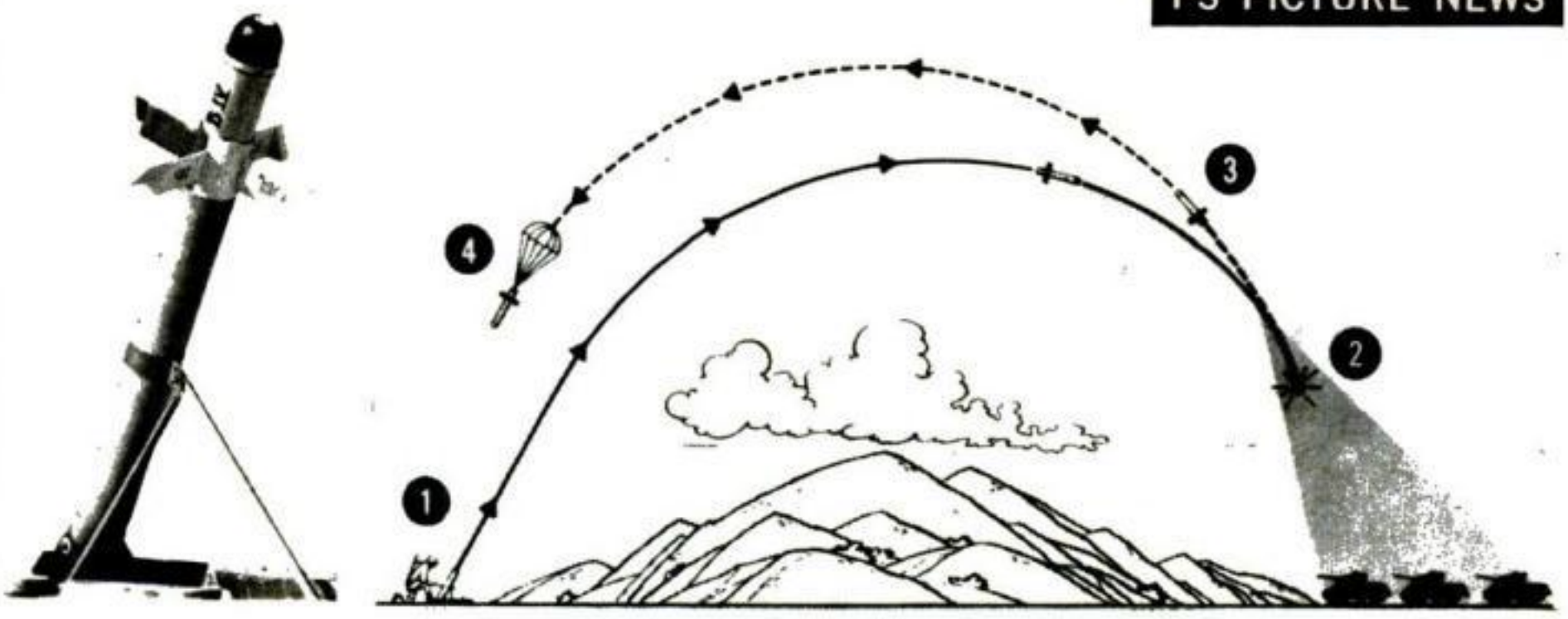

Round-trip missile takes photos

Rockets at both ends of an experimental reconnaissance missile take it over enemy lines and return it to base with photographs of what it sees. Lockheed's lightweight camera-carrying missile, launched (1) by one of its rockets, flies a predetermined distance (2), where it clicks its shutter and fires its second rocket for the return trip (3), to parachute-land (4) near its launch site. Except for firing sounds, the missile is silent. With new rockets, the case can be re-used.

A new station-wagon camper

Mounted on the rear of a Studebaker sliding-roof station wagon instead of a pickup truck, the camper at right provides ample headroom in its kitchen and dining area above the cargo floor. It has a large double bed over the cab. Car seats convert to extra beds.

The camper, made by McNamee Coach Corp., El Monte, Calif., bolts to frame members for riding stability. A closeable entranceway lets passengers pass from station wagon to camper.

to sink into ground. **Fully open, top is flush with driveway pavement.**

hydraulic cylinder recessed in each post. Buried supply and return pipes carry oil to and from a pump and storage tank in a compact sectional-steel unit in the gatehouse. The unit is small enough to be installed in one of the gateposts.

The gate is actuated by a solenoid and a volume-control valve that delivers oil to the two cylinders in accurately measured, equal amounts. Working in oil, the mechanism has virtually no wear, rarely needs replacement.—*Hans F. Kutschbach.*

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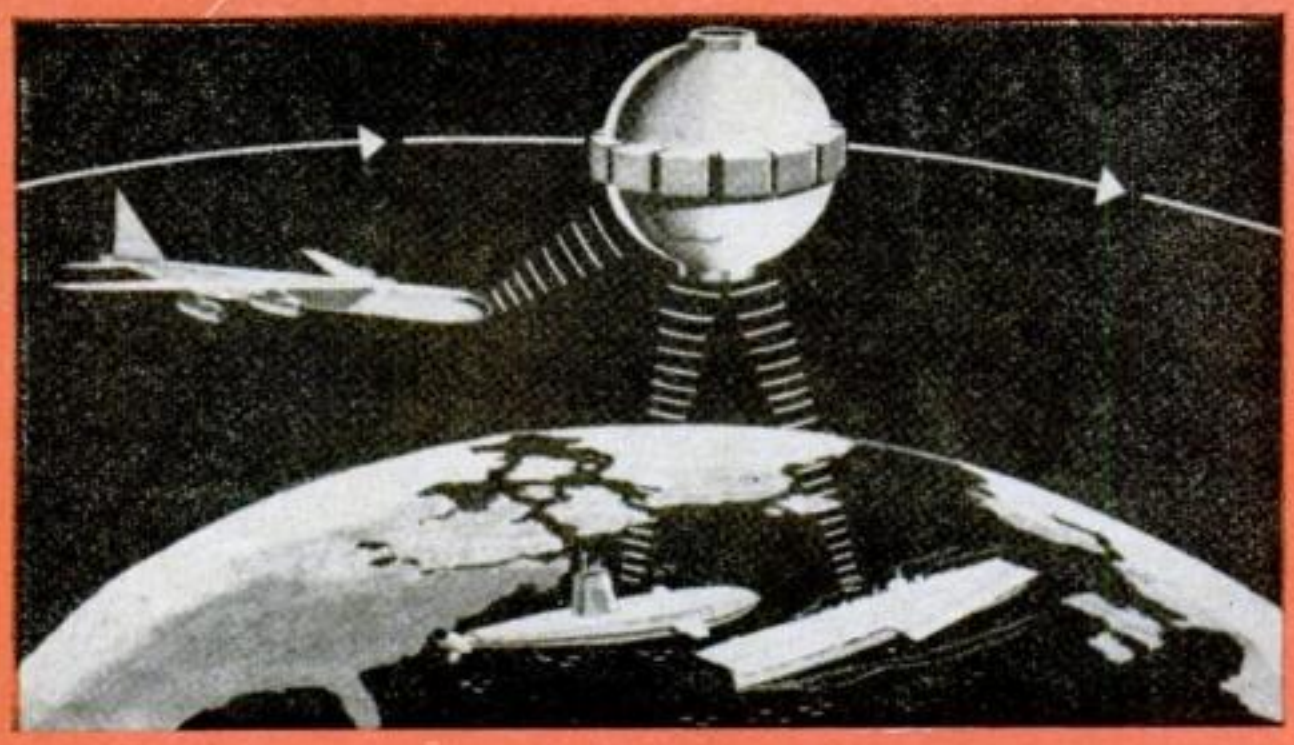

Satellites can provide all-weather, day-and-night navigation system for surface ships, Polaris submarines, and planes, as visualized in NASA drawing of concept. It frees craft from dependence on "shooting" sun and stars as in classical navigation—or on ground-based radio aids, which may not be adequate, or cooperative, where needed.

More accurate than celestial navigation, a new way for craft to get their bearings has been placed in service by the U. S. Navy

Ships and Planes

By Dr. Wernher von Braun

Director of NASA's George C. Marshall Space Flight Center, Huntsville, Ala.

SINCE last July the U. S. Navy has conducted extensive tests of a navigation system for ships that uses three satellites especially designed for the purpose. These Transit satellites were placed in near-circular orbits 600 miles high, by the time-tested Thor-Able Star rocket, from Vandenberg Air Force Base on the west coast. The tests seem to have been highly successful, for the Navy recently declared the whole system ready for operational use.

How can satellites be used to navigate ships? The basic idea is simple:

A small satellite equipped with receiver, transmitter, and a signal-storage device is launched into orbit. Its orbital data, determined by ground tracking stations, are transmitted back to the satellite in suitably coded form—and stored, much as with a tape recorder, by a magnetic memory. Should the satellite gradually change its orbital path, the older information may be replaced by updated tracking data. Thus the satellite, whenever interrogated from the ground about its orbital path, is ready to give up-to-date information. This is the first half of the story.

The other half concerns determining the *relative* position between the satellite and a ship that seeks to learn its own *absolute* position on the globe.

The Doppler shift. This relative position is found by measuring the pattern of the so-called Doppler shift of the satellite's transmitter frequency. Radio Doppler shift is the electronic counterpart of the familiar acoustic phenomenon that the pitch of a locomotive whistle drops as the train passes you. While the train is approaching, the sound waves hit your ear at a frequency higher than that emanating from the whistle. As the train re-

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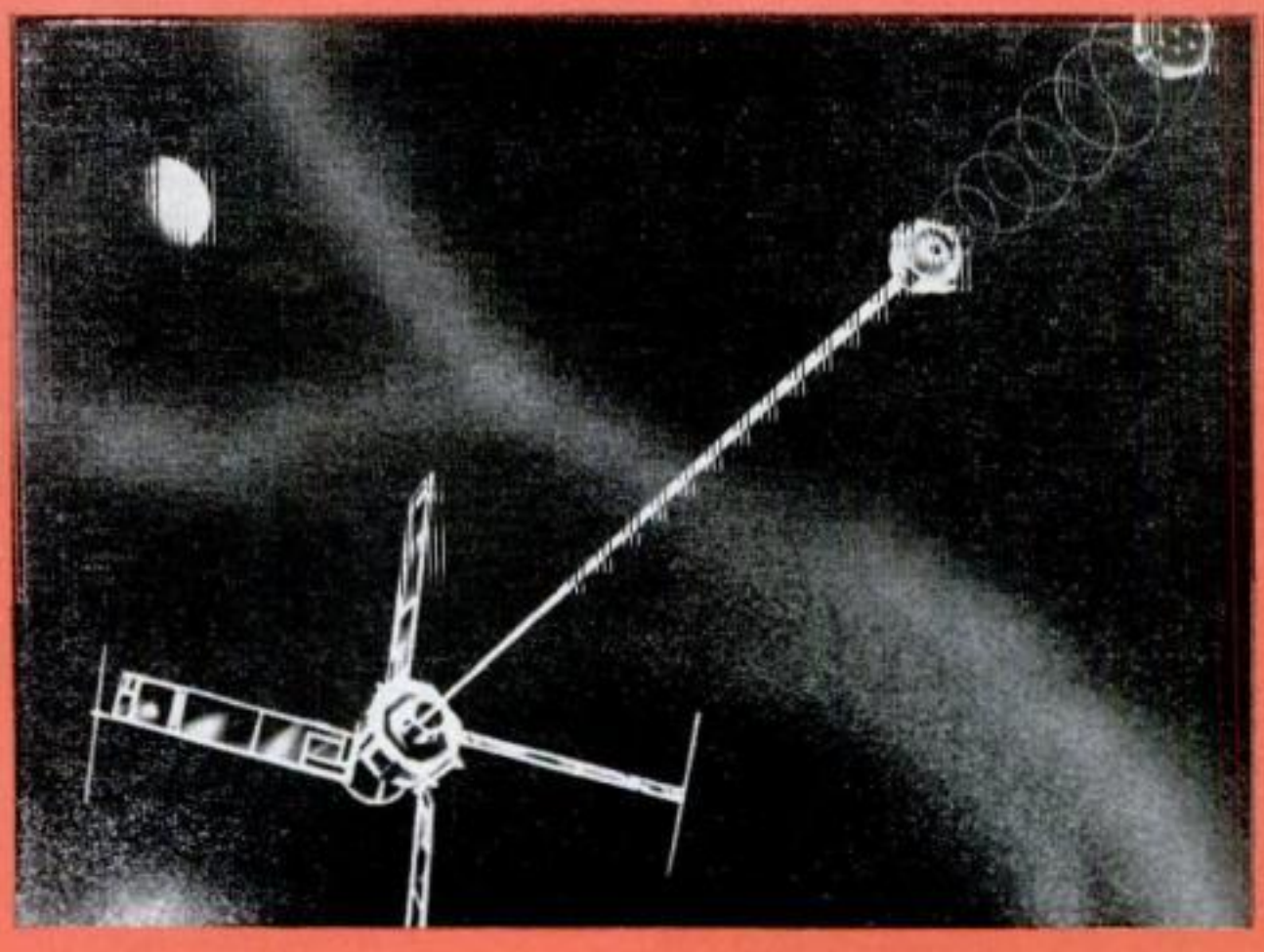


Official Navy drawing shows one of its three navigation satellites currently circling earth in system recently announced to be operational. This one uses solar cells for power. Weight at end of mast gives satellite a dumbbell shape that aligns it with pull of gravity. Spring, linking weight to mast, damps and curbs swaying.

Navigated by Satellites

cedes, you hear a frequency lower than that of the whistle's original tone.

In the case of Transit, the pattern of the Doppler shift from high to low clearly shows the nature of the satellite's pass with respect to the ship. If the change from high to low is rather abrupt, the satellite is at a high elevation. If the change is more gradual, the satellite is lower above the horizon. In addition, the Doppler shift is greater in a head-on overhead pass than in a slanting pass.

A land surveyor finds his absolute position by measuring his relative position against several landmarks whose absolute position he knows. The navigational satellite is only one landmark whose absolute position we know. But, since it is moving with astronomical precision through a predictable, accurately surveyed orbit, it actually offers many precisely surveyed landmarks at different times during one overflight.

With the Doppler-shift data simultaneously providing the relative positions between ship and satellite, the absolute position of the ship can be determined exactly. The Navy says that a navigational fix taken with the Transit satellite system is accurate within about one-tenth of a mile. (Celestial navigation is consistently accurate only to within one-half mile.)

Shipboard equipment used in the Navy's operational Transit tests works automatically. It activates itself when the satellite approaches; receives both the Doppler shift, and the satellite's latest

[*Continued on page 193*]

Dr. von Braun tries periscope of one of Polaris subs, the Von Steuben, aided by satellites.

New Tires Promise

With new tires and new engines, get ready for a record-shattering fight this year at Indy when the old champ (Offy) and the new contender (Ford) slug it out

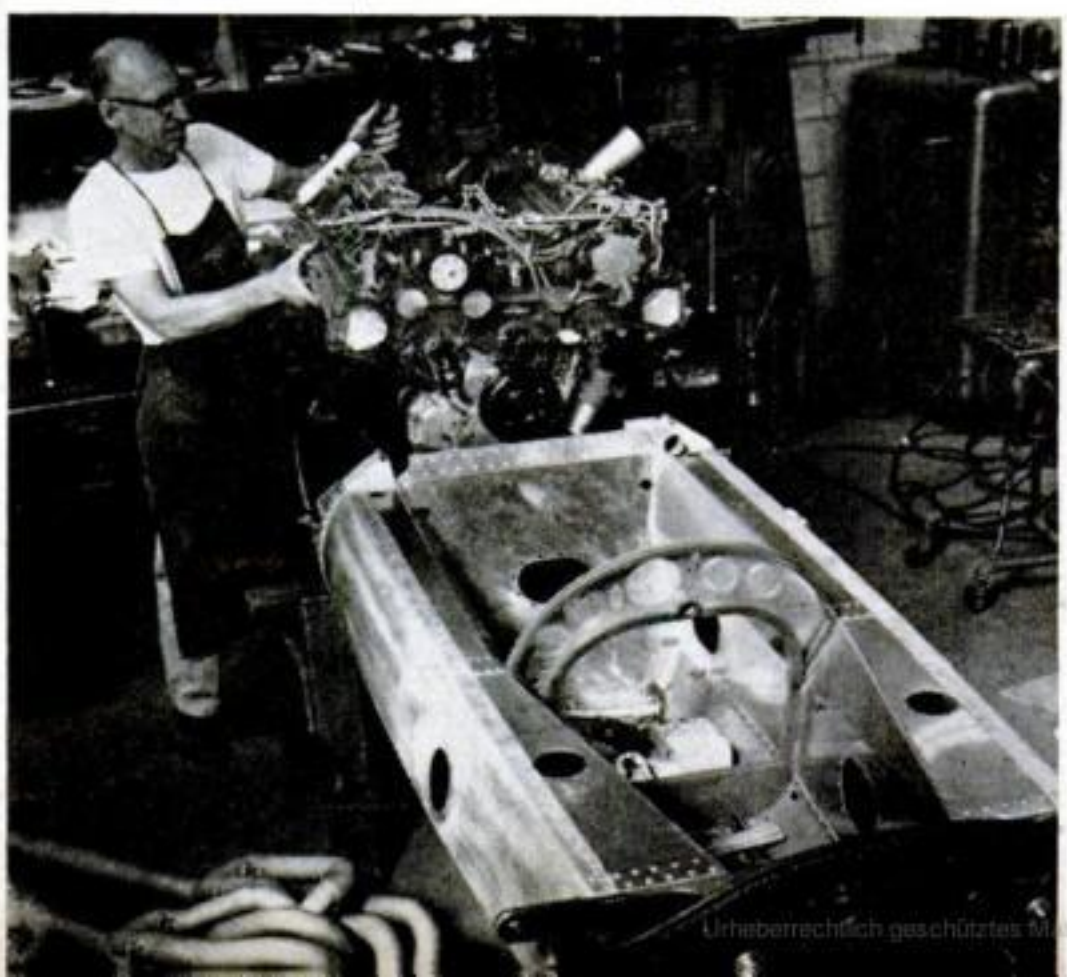
LAST year's unfulfilled promises are going to come true at Indy this Memorial Day. The cars will be even faster in the 1965 speed festival, since they will have more powerful engines and improved tires.

Tires are really the key to what we can expect at the Speedway. The new tires alone, claims Firestone, will raise the average speed of a car from three to seven m.p.h. The speed potential of the new tires is 10 m.p.h. higher than last year's—which means that some cars will approach 200 on the long straights, and we might even see qualifying speeds in the

CONTINUED

Firestone's Jim Thiese measures the nine-inch tread on 12.00 x 16 tire

Veteran Indy car builder Ed Kuzma gets ready to drop the Ford engine into the tail of the Hurst Floor Shift Special. Unit-body frame is built of aluminum; entire chassis is offset.



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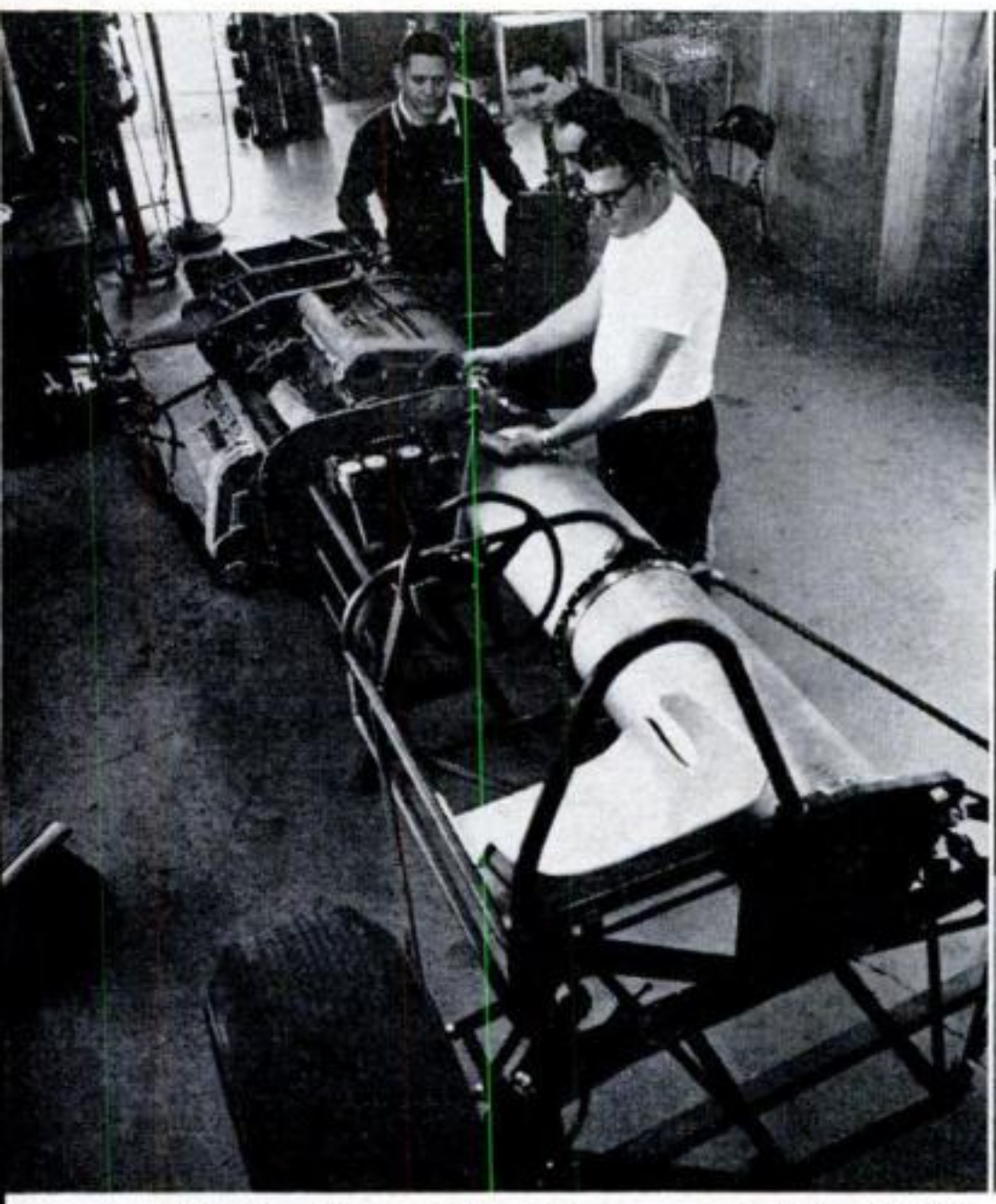
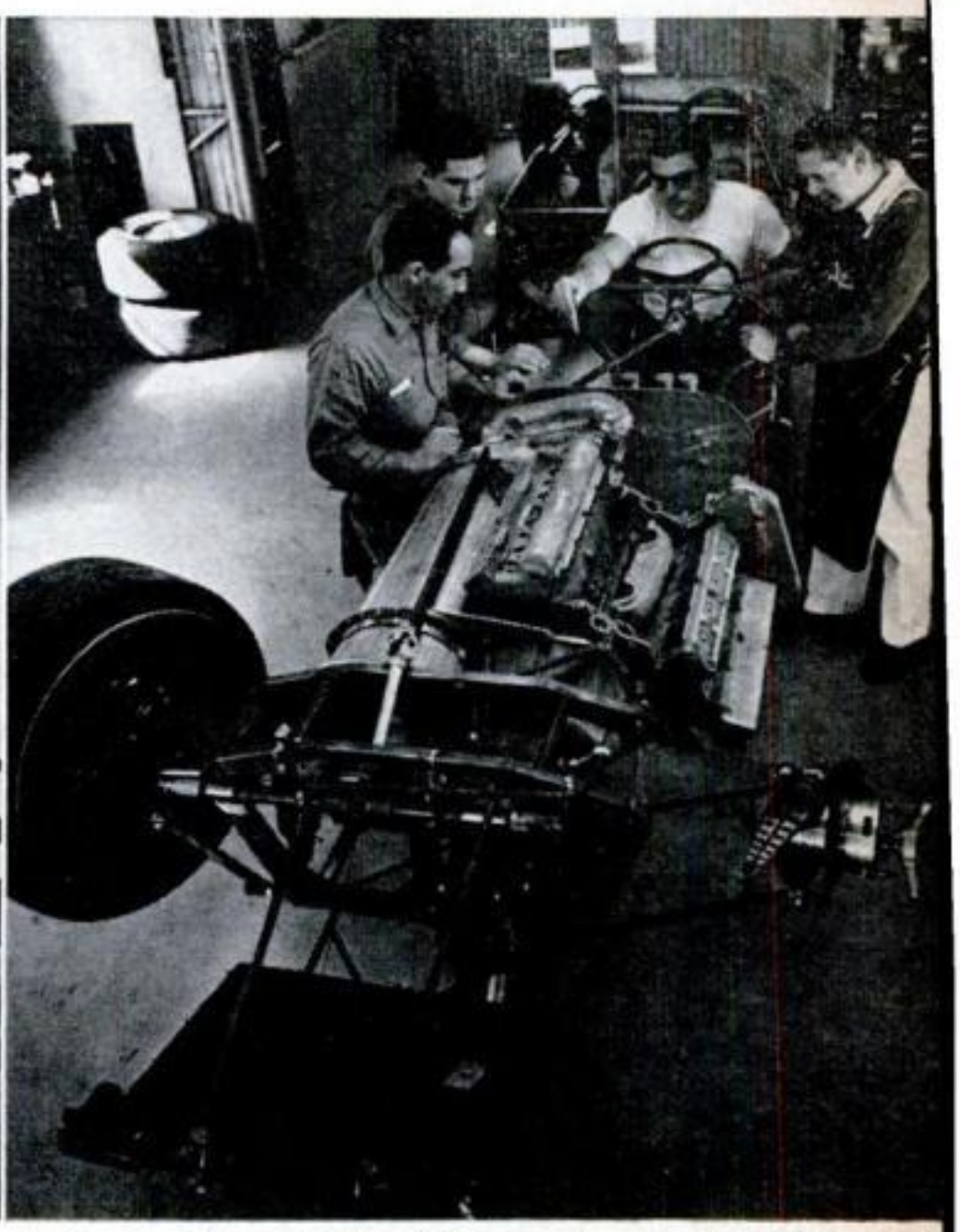
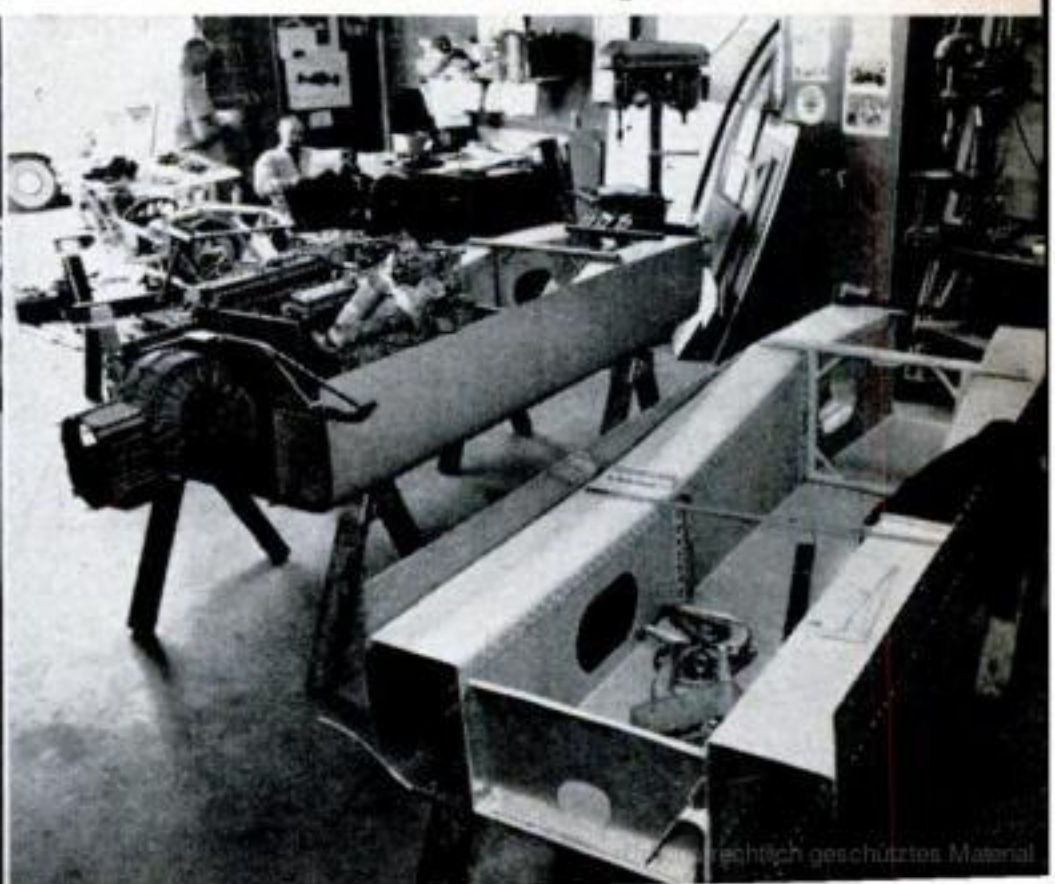
Fastest "500" in History





Wonder Boy Mickey Thompson (white shirt) leads his mechanics in the assembly of his new front-drive car. The engine is a four-cam Thompson special with a Chevy block, mounted back-to-front ahead of the driver and canted to the left. The driver sits offset to the left. On the right, running the full length of the car, is the titanium-frame tube that contains the fuel tank.

A. J. Watson built the cars that won at Indy in 1956, 1957, 1959, 1960, 1962, and 1963. He built his first rear-engine job last year. Now he is building two new ones for Bob Wilke of the Leader Card stable, both with Ford engines. The unit-body aluminum frame (below) has steel bulkheads, and the entire chassis is offset to the left on its suspension.



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Offy-powered rear-engine Federal Engineering Special was built by Ronnie Ward and will be driven by Bob Harkey. The tubular frame is made of chrome-molybdenum steel, and the body is a combination of fiberglass and aluminum panels. All wheels are independently suspended with torsion bars. The dry weight of the car is only 1,370 pounds.

range of 165 m.p.h. In 1964, the race average was a disappointing 143.206 after Jim Clark (Lotus-Ford) had secured pole position by qualifying at 158.828 m.p.h.

The main improvements in Firestone's new tire are in the tread pattern, the rubber compound, and the inner construction materials. It has been possible to save weight while actually increasing tread width. The new tread pattern and the improved rubber compound not only allow higher speeds but also assure better traction and adhesion. All this has been achieved without any loss of durability—the tires will go the full distance. Goodyear and Armstrong have also made great progress in racing tires, but have not yet completed their testing programs of the 1965 Indy tires.

The contenders. Ford engines will dominate the scene, although the lightweight Offy is still in contention. Mickey Thompson's Chevrolet-based four-cam power plant is an unknown quantity, and the Novi, although its reliability record is dim, still puts out more power than any other Indy engine.

The V-8 Novi is supercharged, and its maximum power is about 700 hp. at 8,800-9,400 r.p.m. This compares with about 440 hp. for a well-tuned Offy and 495 hp. for the latest Ford V-8.

Ford has gained 20 hp. since last year by running the engine faster (8,800 r.p.m. against 8,000 in 1964). The increase has been made possible by a complete redesign of the lubrication system, a new fuel-injection system, and reinforcements in connecting rods, bearing caps, and camshafts. To guard against last year's valve-spring failures, each pair of valve springs is assembled by selective fit for more accurate control of spring interference.

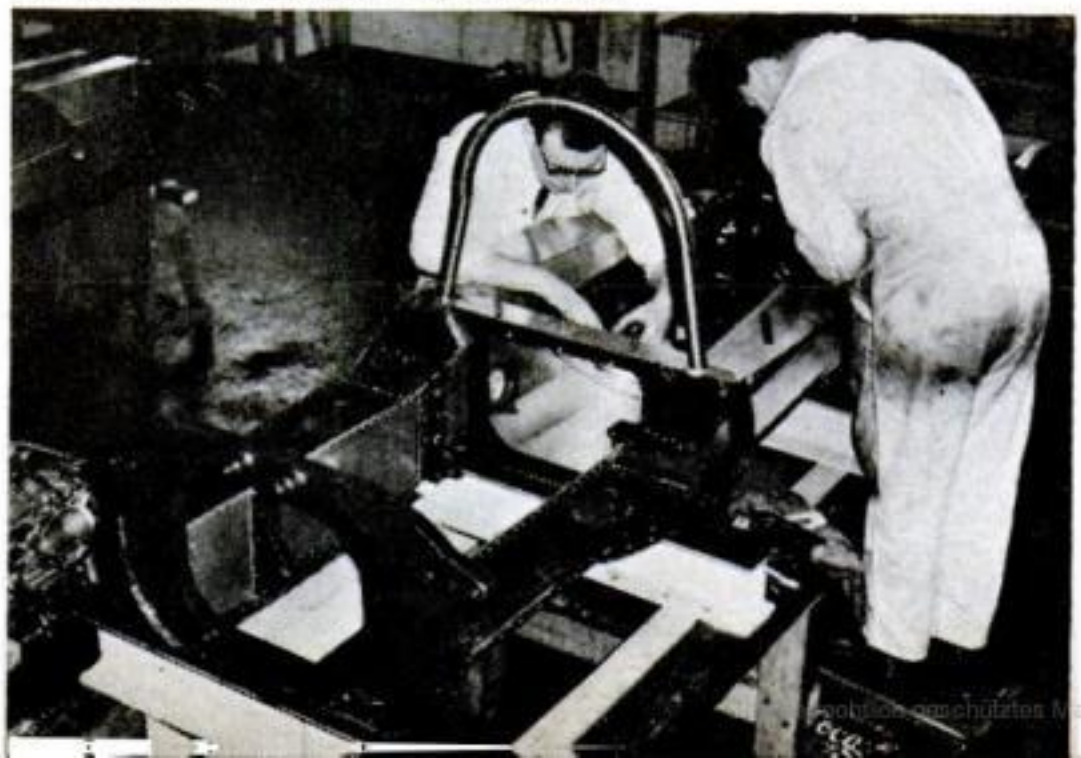
The big news in Ford's injection system is a boost venturi in the induction pipes, giving better fuel atomization before it enters the combustion chambers. This system has also improved the fuel economy. Since two fuel stops are obligatory, what it means for Ford-engined cars is that they can run lighter and therefore accelerate faster. Some 60 cars are expected for the time trials which determine the grid positions of the 33 cars that will actually start in the race.

The traditional Indy roadster will be a rare sight at the Speedway. Most of the cars will have rear engines in the style pioneered at the Brickyard by Brabham and Lotus, but there will also be front-drive and four-wheel-drive cars with front-mounted engines (Mickey Thompson and STP-Novi).

Bobby Unser's enormous 1964 Novi-powered STP Special is being repaired, and a new chassis, four inches shorter,

[Continued on page 196]

BRP's Tony Robinson directs assembly work on the two cars being built in England for Indy entry by George Bryant. Both of them will have rear-mounted Ford engines and will run on an alcohol-based fuel mixture.



Rubber-Lined Gas Tanks to Make '65 Race Safer

This is the fourth and final article on the Indianapolis 500 by POPULAR SCIENCE's *popular columnist, Smokey Yunick—who worked on the car that won in 1960. In it he tells the inside story of last year's fatal accident, and predicts the winner of the 1965 race.*

By Smokey Yunick

A YEAR ago this month two drivers were burned to death at the end of the second lap of the Indianapolis 500, racing's most famous event. The circumstances that caused the accident may never recur. New safety rules will help. But they are only part of the story.

On the surface, ruptured gasoline fuel tanks took the lives of Dave MacDonald and Eddie Sachs. So here are the new rules:

- Drivers must refuel twice during the race. (This rule is for the birds. It's still possible for a 1,250-pound car to carry a 500-pound load of highly flammable fuel).
- Fuel tanks must have rubber liners to help prevent spillage in case of impact.
- No tanks may be located in front of the driver. No side-mounted tanks may extend laterally beyond a line drawn through the inside edge of the wheels, front to rear. (There are other good, solid rules on fuel systems and cars in general.)
- Finally, pressure refueling is out.

Critics of gasoline-powered racers contended after last year's accident that use of gas was responsible. This was not true. It could have happened with any fuel. Some Offenhauser racers tried to blame gasoline for the tragedy because Offies, for some time wedded to special fuels, are supposed to be at a disadvantage in the horsepower department on gas.

The real truth is that the causes of the accident go deeply into the background of the people concerned. The unwritten code of good driving and racing practices was violated. Personal animosities in the racing teams (between drivers and mechanics, for instance) played a part. Beyond that I cannot go. But the racing fraternity itself knows exactly what happened. It will, I am sure, see to it that the circumstances are not duplicated.

We have already stated in this space that a Ford engine is almost bound to win this year. Ford has more entries, more good drivers, organization, experience, and less competition.

Reduced to ultimate simplicity, you win the 500 by getting the maximum power from a pound of fuel, doing the best job of overcoming centrifugal force on the turns, throwing in a team (money, driver, mechanic) whose components are in perfect rhythm with each other and with the race, *then* building in reliability, and *finally* sprinkling the whole thing with luck.

Better shoes. Tires, today, are remarkably better. Up to 1962, little had been done to change tire characteristics. Tires wore out rapidly, and would not hold in the turns. They were narrow 16-inchers in front and narrow 18-inchers in the rear.

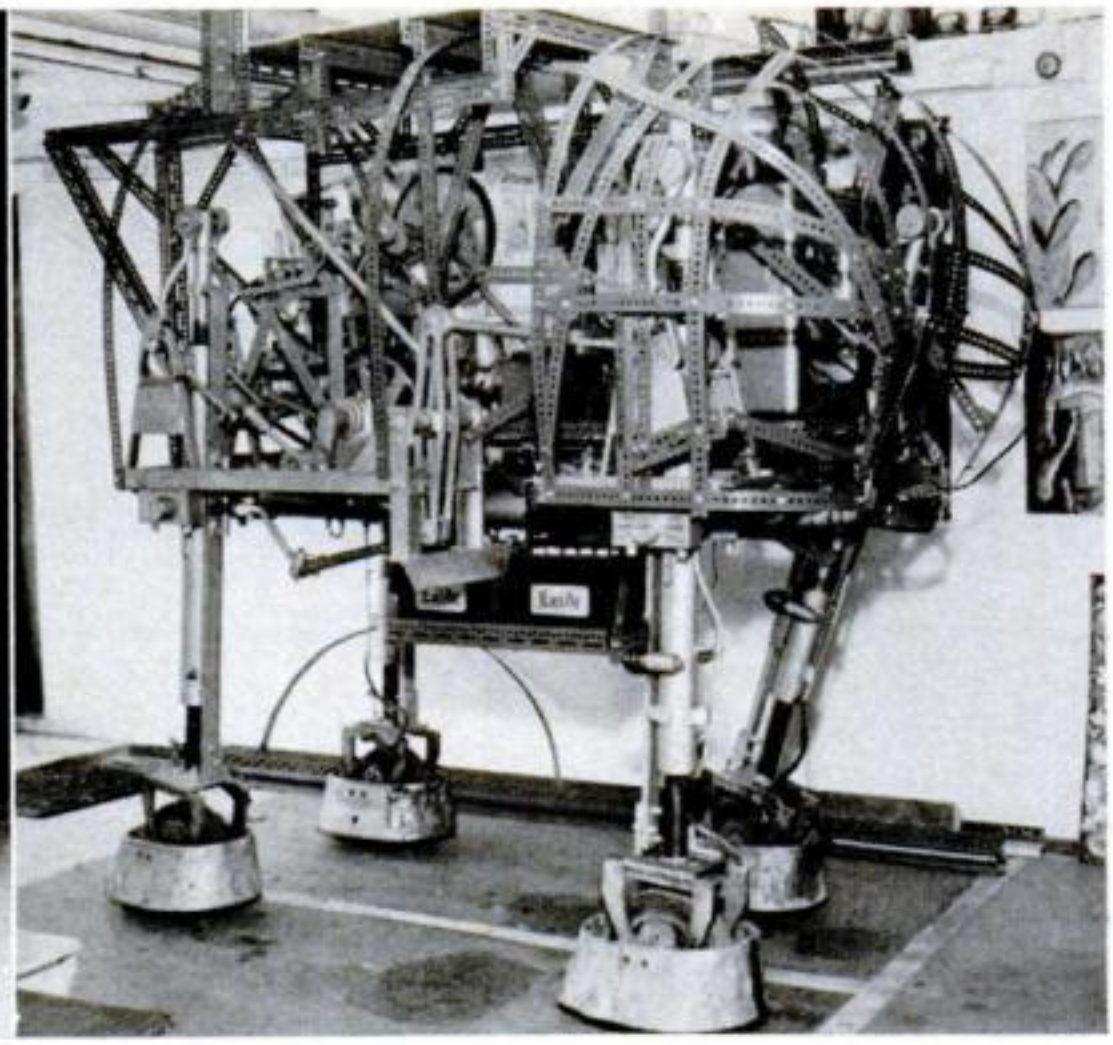
John Laux, then with Firestone, now with Goodyear, was farsighted. He was not satisfied. In 1958 I suggested 15-inch tires, only to find that Laux was ahead of me. In 1962 I made my move, but had to accept a compromise—16-inch tires, still as hard as iron, having a narrow tread without a smooth tread design, and a narrow profile.

In 1963 Mickey Thompson shocked everyone with 12-inch treads on 12-inch rims. From his vision, the message finally got through to the tire companies. The tires you see at Indy this year will, like those of '64, go the entire distance—and are a development, you have to bear in mind, of only the last three years.

Who's going to win this year's 500? I'll tell you—a man named Parnelli Jones.

Urheberrechtlich geschütztes Material

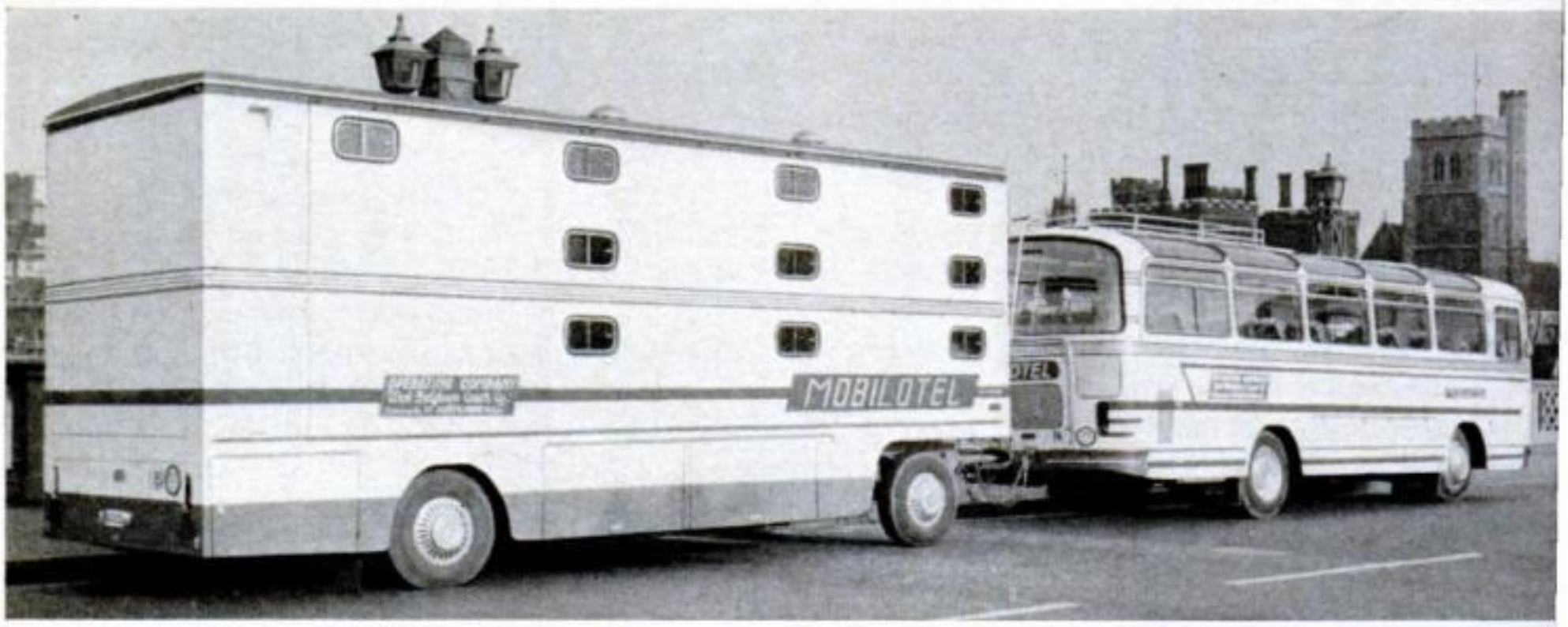
Realistic hand-sewn "hide" is chemically treated reinforced wool and paper.



Back legs (right) propel animal, front legs steer. Five 12-volt batteries fit under the steel frame.

Mechanical elephant looks real

This battery-driven elephant looks so much like the real thing that people have complained of its treatment. Built for a British ice show, it annoyed some to see it walk on ice. Guided by controls in the neck, it's powered by a one-hp., 50-volt motor with 30 walking speeds up to six m.p.h., can achieve a trot at 23 m.p.h. Frank Stuart, of London, who built a gasoline model 15 years ago, offers it for sale to amusement parks. Its howdah (topside box) holds eight adults or 16 children.



Dormitory trailer towed by coach on low-cost tours furnishes sleeping quarters for travelers in hotel-less areas. Coach and trailer are air-conditioned for cool comfort in the desert.

Rolling hotel trailer expands to provide 36 berths

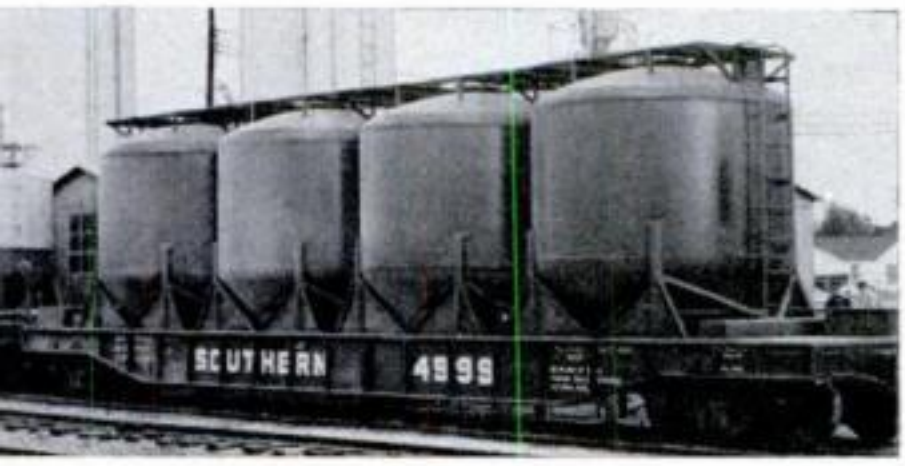
A British coach for offbeat tours to the Middle East and North Africa tows its own hotel for on-the-spot accommodations in primitive lands. The trailer, 24 feet long and 8 feet wide, cranks out to a width of 14 feet at overnight stops. It has nine

Urheberrechtlich geschütztes Material

Flying television camera

The toy-size unmanned helicopter at right, ground-controlled by coaxial cable, carries a TV camera for surveillance behind enemy lines.

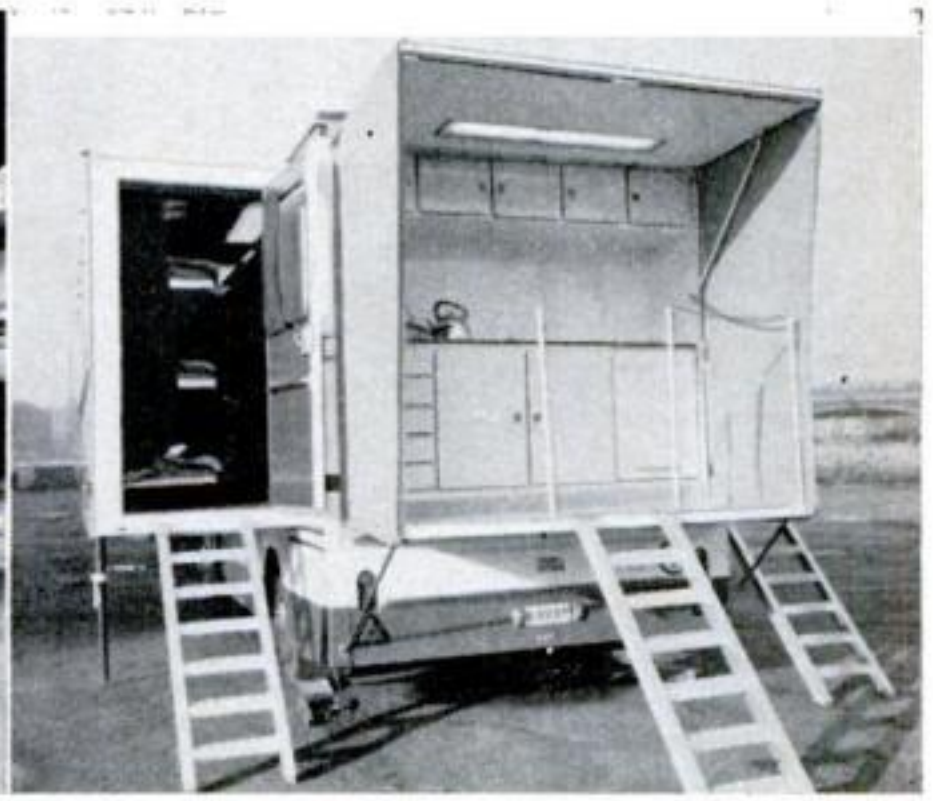
Built by the Canadian Armament Research and Development Establishment, the Periscopter flies on a 4½-foot rotor, provides a 360-degree view through closed-circuit television.



Rail car has four teardrop tanks

The four teardrop containers on the chassis of the tank car above carry dry or liquid cargoes on the Southern Railway. Air pressure and flexible hose unload its 3,200-cubic-foot load into trucks in an hour. The car, designed by Halliburton Co., can handle four different products at a time.

Curtained cubicles sleep 36 in three-tiered single berths at sides, double beds in center.



Flanked by dormitory entrances, back opens into a kitchen for cooking light meals.

curtained-off three-decker single beds on each side, nine double beds in the center. The back, flanked by entrances to the dormitory, opens up into a kitchen for breakfasts and light suppers. A portable generator under the floor is trundled out at night to provide electricity for air conditioning, lights, and cooking. The coach, also air-conditioned, has reclining seats, radio, and a public-address system.

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Popular Science AWARD

POPULAR SCIENCE
1890 ICS 1965
AWARD

This month, Popular Science proudly announces another in its series of Awards introduced to give recognition to companies and individuals for outstanding contributions to American living, as measured by their importance to PS readers. The fifth selection of the Popular Science Editorial Board is the

International Correspondence Schools

Not only is it a leader in traditional correspondence education, but ICS is also a pioneer in industrial retraining and Educasting—a revolutionary new method of television instruction.
These developments, coupled with its 75 years of outstanding service in providing the tools for self-education to over 7,000,000 students, have earned the Popular Science Award for the International Correspondence Schools. This institution is a fitting recipient of the Award because it provides teaching that retains the best of proven methods while pioneering new and promising techniques.

Ernest V. Heyn
Editor-in-Chief

John R. Whiting
Publisher

Educating

Postmen ring the schoolbell for over 4,000,000 men working up to better-paying jobs

By Herbert Shuldiner

A student tests electronic equipment that he built as part of his work for an International Correspondence Schools electrical-engineering course. He's surrounded by 144 texts he will have waded through by the time he has completed the course.

NINE years ago, Jess Mattingly, who never got past the fifth grade, was a $43-a-week factory hand in Oklahoma City. Less than two years later, he was a plant superintendent earning $165—nearly four times his original pay.

Allan R. Cannon finished high school in San Juan Capistrano, Calif., but the best job he could get after graduating was as a gas-pump jockey. A year later, he was an architectural draftsman, building a fine future for his growing family.

August J. Billitier was a young mechanic in a metal shop—with little likelihood of advancement. Suddenly, he began getting promotions, climaxed by his appointment to assistant foreman of the Bausch & Lomb maintenance department in Rochester, N.Y.

The secret: home study. Were these just lucky breaks? Hardly. Spare-time study sparked these sudden changes of fortune. If you lack the education for a better-paying job—or if you want to upgrade your skills—you can join four million other Americans making their own breaks by home study. From grade-

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Yourself

school dropouts to college graduates, they're qualifying for skilled, automation-proof jobs—and they're learning better-paying trades without having to quit their jobs or pull up roots.

More than 700 private correspondence schools offer you one of the greatest sources of job-oriented study available. There are also numerous colleges, universities, and state education departments that offer correspondence studies designed to help you get ahead. (You can obtain further information about university extension schools by writing to the National University Extension Assn., University of Minnesota, Minneapolis, Minn.)

You can study almost anything by mail, from elementary-school-level subjects to advanced technical subjects. Chicago's LaSalle Extension University offers law and accounting; the RCA Institutes of New York City, electronics and electrical studies; the Famous Artists Schools of Westport, Conn., creative writing, photography, and art—all through correspondence.

Towering over this multimillion-dollar industry is the giant International Correspondence Schools of Scranton, Pa.,

CONTINUED

This distinguished group of ICS alumni used correspondence study to get ahead

Eddie Rickenbacker, pioneer aviator

Stuart Symington, U.S. Senator

Arthur Godfrey, television star

Dan A. Kimball, ex-Navy Secretary

Luther Hodges, ex-Commerce Secretary

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Principal of ICS School of Engineering Drawing, John A. Klein, reviews instructor's corrections on test. Supervisory spot checks of test papers are typical of ICS thoroughness.

Post Office branch located right in ICS schoolhouse sends tons of educational materials to students every day and facilitates swift processing of the test papers of its students.

which pioneered home study in the United States. ICS has refined self-instruction to a high point while tutoring more than seven million students since its founding 75 years ago.

Its 14 schools within the Scranton "campus" offer over 225 courses (at least 100 exclusively) to about 120,000 students annually. The ICS curriculum is rich in skills where the help-wanted sign is always out—computer programing, electronics, air conditioning, science, and chemical engineering. It's also loaded with high job-potential courses in automotive maintenance, drafting, plumbing, shop practice, and white-collar skills.

About 85 percent of ICS students sign up for job-related subjects. Nearly 20 percent are studying for a high-school diploma, to pass minimum industry requirements for higher-paying jobs.

The average age of ICS men is 24 to 27. John C. Villaume, president of ICS, said recently that this age group has "some uncanny awareness—like a built-in time clock—that warns people in their late 20s that the time for self-improvement is at hand. For it is at that magic age, on the very threshold of their maximum achievement level, that the great majority sign up for a home-study education."

But ICS enrollment is by no means limited to men in their 20s. A recent survey by the school revealed that students' ages ranged from 12 to 82. And the number of older students is growing as demands for retraining increase.

Many ICS students study in company-sponsored apprentice or journeymen upgrading programs. ICS has contracts with over 7,000 U.S. companies and trade unions, to train personnel.

How you sign up. ICS won't sign you up by mail. The school has over 800

[*Continued on page 194*]

How to pick a correspondence school

Most mail-order schools are reputable enterprises. But there are some abuses. You should investigate thoroughly before you sign a contract for any course. Remember, reputable schools welcome investigation. They don't try to pressure you into a quick commitment. If in doubt, check the Better Business Bureau in the city where the school is located.

The National Home Study Council, 1601 18th St., N.W., Washington, D.C. 20009, is another agency that will give you information on correspondence schools. The NHSC is a national accrediting agency approved by the U.S. Office of Education. On request, the Council will send you a free list of its 71 member schools, with addresses and courses.

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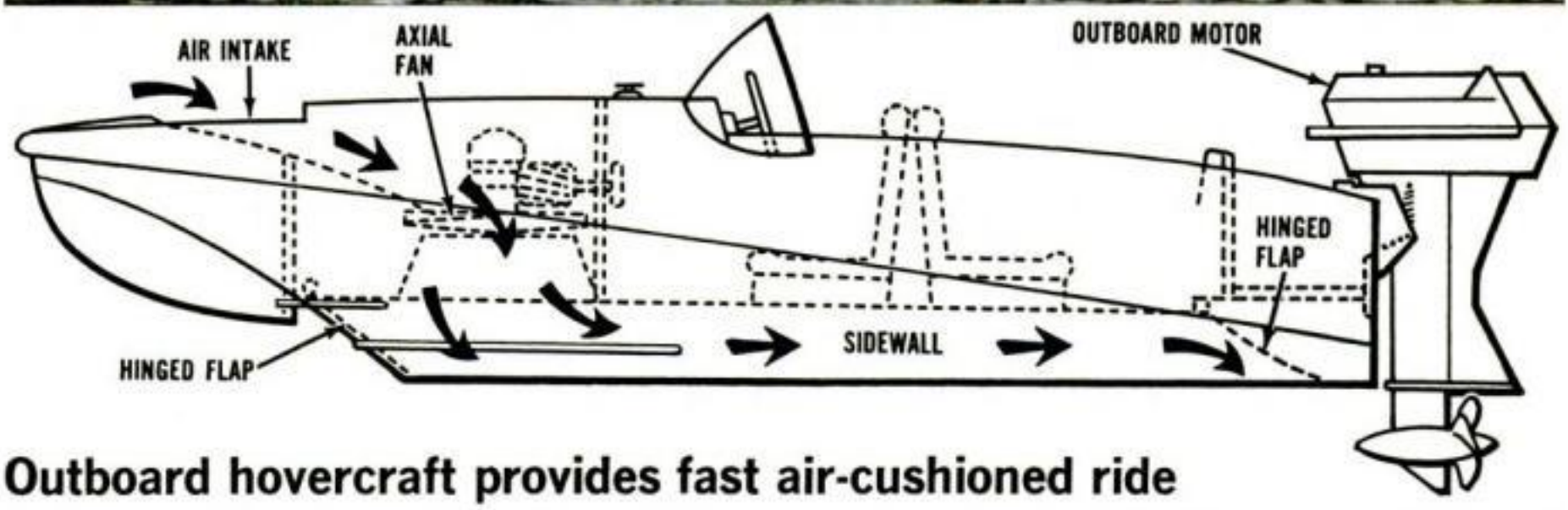

Outboard hovercraft provides fast air-cushioned ride

This new hovercraft powered by a 50-hp. outboard motor cruises smoothly at 40 m.p.h. while floating above choppy water on a 12-inch cushion of air. Pressurized at 30 pounds per square inch by an axial fan driven by a 10-hp. air-cooled two-stroke engine, the air is confined in a pocket by vertical sidewalls and hinged flaps fore and aft. The sidewalls also prevent drift and skidding on fast turns. With the fan cut off, the boat floats as steady as a raft on its flat bottom.

The British fiberglass Dynacraft is 15¼ feet long, seats up to five people.

Conversation is carried on through pipe held in mouth.

Device that fits in bowl contains microphone, loudspeaker, four transistors, and battery. Screen on top looks like tobacco.

Talking through his pipe

When Johnny Hennings lost his larynx in an operation, he could talk only in an inaudible whisper. So the Danish artist turned to his electronics hobby and built a public-address system so small that he could fit it in his pipe to magnify the sounds coming through. In the pipe bowl besides a microphone and loudspeaker are a tiny 5.8-volt battery and four transistors. A screen on top keeps them in place.

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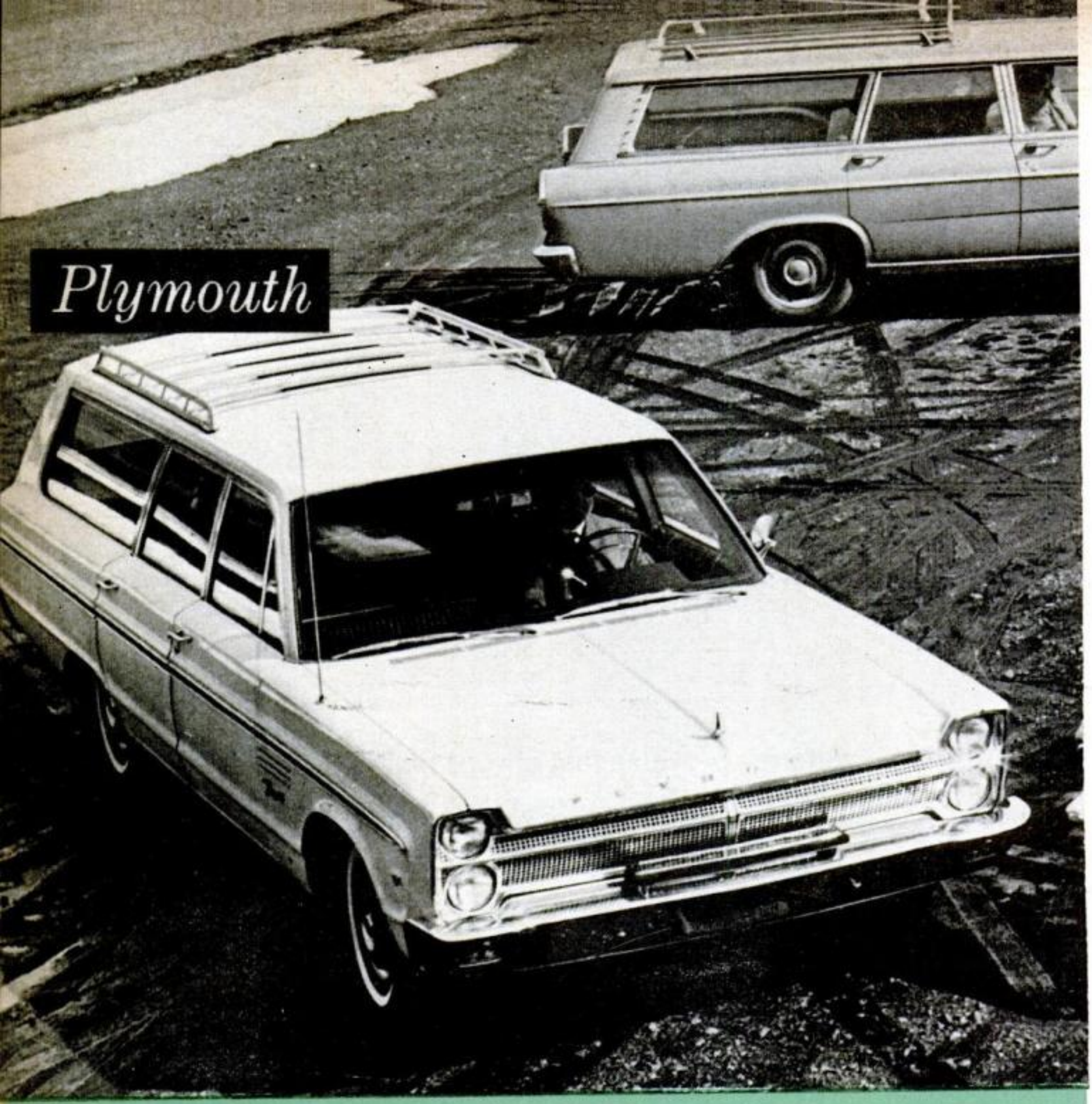


REPORT FROM THE DRIVER'S SEAT

Test-Driving the Big 3

Whichever you choose, don't ever call any of these luxurious, smooth-riding wagons "family trucks"

CHANCES are that one of these three cars will be the first you look at, if you're in the market for a full-size wagon. Although they may seem as much alike as peas in a pod on first inspection, there are important differences you should know about before you buy:

If you habitually carry heavy loads in your station wagon, the Plymouth is for you. For all-around use, we'd pick the Chevrolet. On quality and reliability, we would give all three an excellent rating.

Station Wagons

By Jan P. Norbye

• The Plymouth has the highest load capacity, but gives the harshest smooth-road ride when unladen.

• The Chevrolet has the most comfortable driving position, but the least satisfactory transmission.

• The Ford has the most accurate speedometer—least fade-resistant brakes.

We chose to test all three equipped with base-model V-8 engines, automatic transmissions, power steering, and popular options such as electric tailgate windows, radios, luggage racks. The base price of the Impala is $3,077—as tested $3,729.70; that of the Ford Country Sedan, $2,964—as tested $3,553.35;

CONTINUED

and that of the Plymouth, $2,981—as tested $3,876.35.

The keenest competition for these wagons, which account for almost half of all station-wagon sales, comes from the intermediates in their own families —Chevelle, Fairlane, Belvedere. These, together with the BOPettes (compacts by Buick, Olds, and Pontiac), Dodges, and Ramblers, make up most of the remaining half of the station-wagon market.

Obviously, many people find the full-size station wagons too big. With overall lengths up to 216.1 inches (Plymouth), they are undeniably large, but they are also extremely versatile.

Their utilitarian aspect has been carefully disguised. Yet they are not overly glamorous. They are just big, comfortable, no-nonsense station wagons, no longer a status symbol of suburban luxury, but multipurpose vehicles equally suited for everyday transportation, vacation trips, local delivery service, and airport limousine duty.

How do they ride? They look, ride, and handle remarkably like the sedans on which they are based, especially the Ford and the Chevy, which share the 119-inch wheelbase of the sedans. Plymouth has added two inches of wheelbase for the wagon.

The Ford and Chevy wagons have coil springs all around—the Plymouth has torsion bars at the front and semi-eliptic leaf springs at the rear. Ride comfort is not much affected by load in the Impala and the Ford, while the ride improves considerably in the Fury wagon with a few hundred pounds of cargo in the back.

When lightly loaded, the wagons can be driven like passenger cars, and their cornering behavior is quite normal. Chevrolet uses a one-inch-wider track on its wagons than on its sedans, and the Impala wagon also had the widest track of the wagons on test. Naturally, it feels the most stable on turns.

Plymouth has a good reputation for handling, but it was won by the sedans and not by the station wagons. Ford continues to suffer from a front suspension system whose steering geometry tends to become indecisive as soon as the wheels hit a bump. Bumpy turns will cause a severe loss of handling precision in the Ford.

The Ford's rear-axle suspension is possibly the best in the industry. The axle casing is carried by two long trailing arms and kept from twisting by a short

CHEVROLET takes a high-speed turn in an even sweep with little or no steering correction required, but it leans more than the Ford.

CHEVROLET wagon, with its rear seat folded, just exactly holds a four-by-eight-foot plywood panel laid flat on the floor.

CHEVROLET rear coil springs bottomed under 3,710-pound load (car weight at rear wheels, 2,350 pounds; 17 bags of cement, 1,360).

Urheberrechtlich geschütztes Material

FORD corners flatly but demands incessant steering corrections. Rear end is better than the front—very stable and always in control.

PLYMOUTH has superior directional stability. It is considerably heavier than the sedan and more of a handful when you drive it fast.

FORD Country Sedan has the same floor space as the Chevrolet, and also offers greater interior height (35 inches against 31 inches).

PLYMOUTH has narrower cargo space and does not allow the plywood panel to lie flat. Height is the same as in the Impala (31 inches).

FORD springs proved able to give approximately the same ride rates as Chevrolet, and also supported the same load before bottoming.

PLYMOUTH rear leaf springs ruggedly supported the weight of the car, plus an amazing 1,600 pounds before hitting bump stops.

torque-reaction member on the right of the differential. It is located sideways by a track rod. While a similar system is used on the Chevrolet sedans, Chevy's wagon has a four-link axle-location system patterned on that used in the big Buicks and Oldsmobiles.

The rear axle in the Plymouth has freedom to move in undesirable ways on deflection, since it is located solely by the leaf springs. They cannot eliminate spring wind-up and axle twist, nor do they provide positive lateral location. This is the weak point in the suspension design of the Chrysler product, for the Torsion-Aire front suspension is superior to most U.S. independent front ends.

Ford has managed to diminish nose-dive on braking to a surprising extent (this was a severe complaint against the

CONTINUED

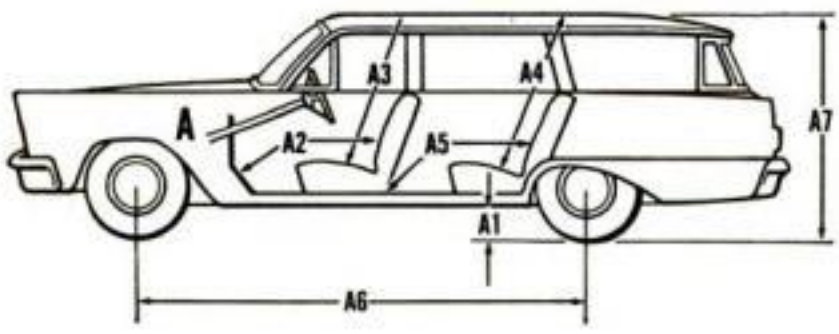
Urheberrechtlich geschütztes Material

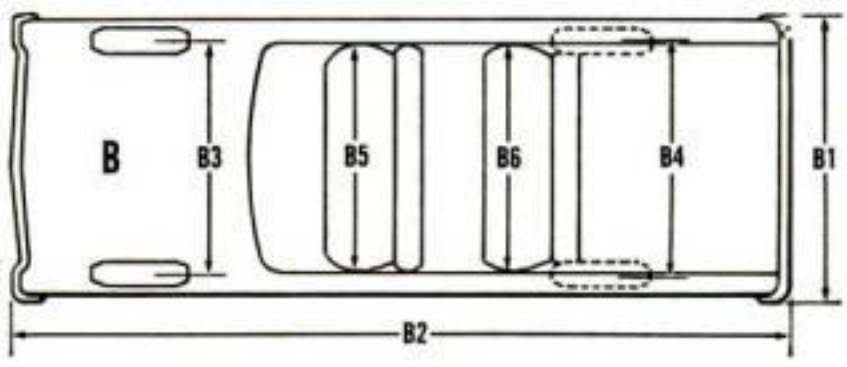
Acceleration tests were made with a Heuer ink-spot stopwatch and fifth-wheel speedometer.

1964 Ford). Plymouth never had much of a problem in this respect, and it is the Chevrolet which has the most noticeable nose-dive. The Chevrolet also leans most on turns, although the wagon has a heavier stabilizer bar than the sedan. Body roll and nose-dive never assume excessive proportions, however, and the Impala's overall handling precision is superior to that of its challengers.

The engines. Engine performance is adequate rather than satisfactory in all

[*Continued on page 208*]





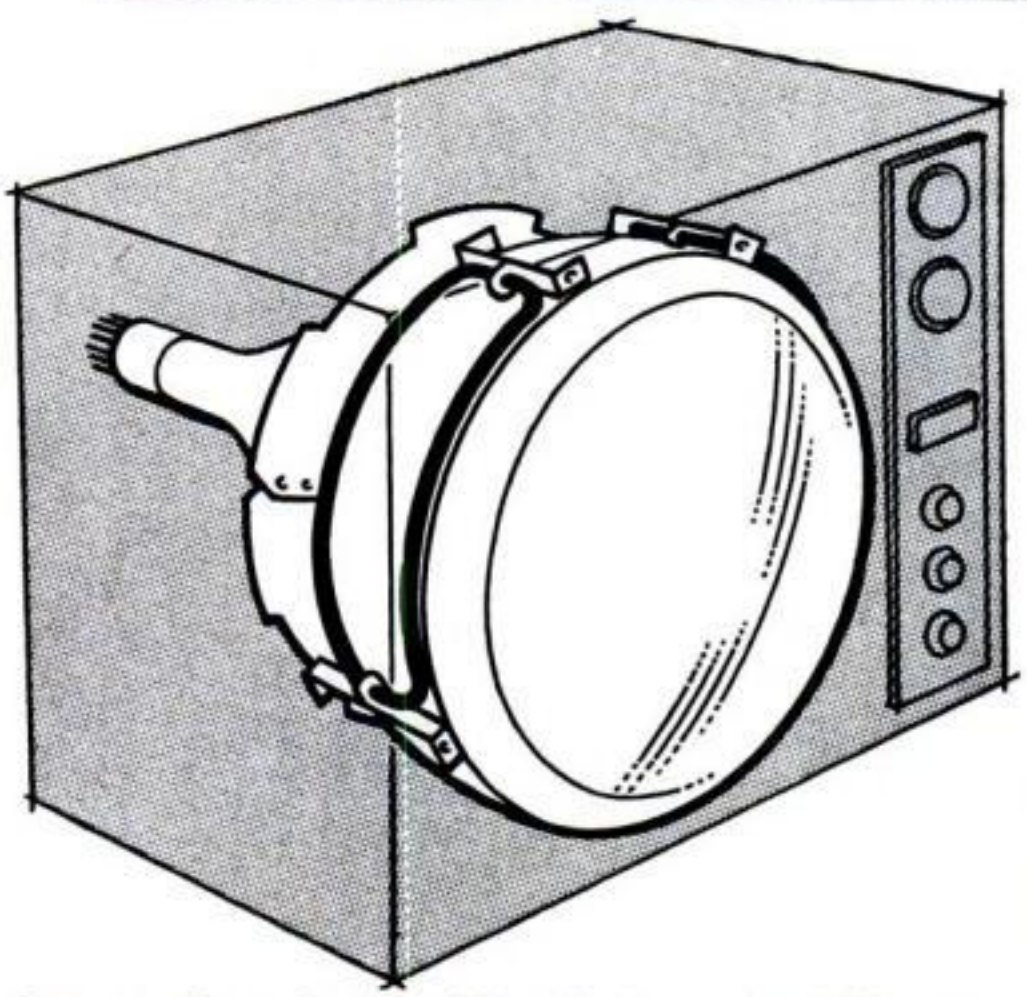
	CHEVROLET Impala Wagon	FORD Country Sedan	PLYMOUTH Fury Wagon
DIMENSIONS (inches)			
A1 Ground clearance	6.3	6.1	5.8
A2 Front legroom	42.0	41.4	39.6
A3 Front headroom	39.3	38.6	39.6
A4 Rear headroom	39.1	40.0	39.6
A5 Rear legroom	38.3	37.3	38.6
A6 Wheelbase	119.0	119.0	121.0
A7 Overall height	56.5	56.7	57.5
B1 Overall width	79.6	77.3	78.1
B2 Overall length	213.3	210.0	216.1
B3 Front track	63.5	62.0	62.0
B4 Rear track	63.4	62.0	60.7
B5 Front-seat width	63.6	62.6	63.3
B6 Rear-seat width	62.9	62.7	63.5
SPECIFICATIONS			
Engine type	OHV V-8	OHV V-8	OHV V-8
Bore & stroke	3.87 x 3.00	4.00 x 2.87	3.91 x 3.31
Displacement	283 cu. in.	289 cu. in.	318 cu. in.
Compression ratio	9.25:1	9.3:1	9.0:1
Carburetion	Single 2-bbl.	Single 2-bbl.	Single 2-bbl.
Fuel grade	Regular	Regular	Regular
Horsepower	195 @ 4,800	200 @ 4,400	230 @ 4,400
Torque	285 @ 2,400	282 @ 2,400	340 @ 2,400
Transmission	Powerglide 2-speed and torque converter	Cruise-O-Matic 3-speed and torque converter	TorqueFlite 3-speed and torque converter
Final drive ratio	3.31:1	3.00:1	2.93:1
Tire size	8.25 x 14	8.15 x 15	8.55 x 14
Steering ratio	24.0:1	21.9:1	18.8:1
Turns (lock to lock)	3.6	4.0	3.5
Turning circle	39.5 ft.	41.5 ft.	43.0 ft.
Brake-swept area	328.3 sq. in.	316 sq. in.	328 sq. in.
Curb weight (as tested)	4,185 lb.	4,125 lb.	4,300 lb.
Retail price	$3,729.70	$3,553.35	$3,876.35
PERFORMANCE			
0-60 m.p.h.	14.8 sec.	14.2 sec.	13.3 sec.
0-80 m.p.h.	36.0 sec.	30.6 sec.	26.0 sec.
40-60 m.p.h.	7.2 sec.	7.0 sec.	6.8 sec.
50-70 m.p.h.	10.7 sec.	9.8 sec.	8.8 sec.
SS quarter-mile	20.14 sec.	19.84 sec.	19.22 sec.
Overall fuel mileage	13.8 m.p.g.	13.6 m.p.g.	12.7 m.p.g.

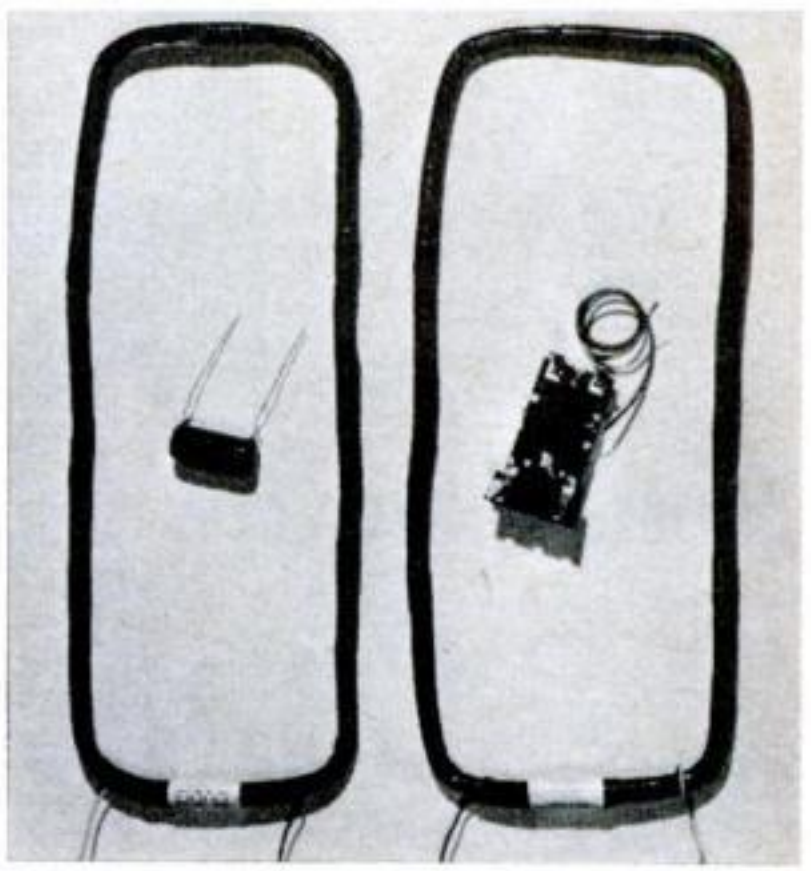
Urheberrechtlich geschütztes Material

what's new in ELECTRONICS

A multi-tester for your CB rig

This compact multifunction test instrument will help you keep your Citizens Band transceiver adjusted for peak performance. It measures the power and relative field strength of the output signal; tests both transmitting and receiving crystals; checks for proper antenna connection; monitors modulation. $37.50. Lafayette Radio, Syosset, N.Y.





Automatic color-purifier kit for color TV sets

A new degausser kit makes it simple to add automatic color purifying to any 21-inch color TV with a round picture tube. Most late-model color TVs have built-in automatic degaussers that demagnetize the picture tube's shadow mask each time the set is turned on. Even a tiny bit of shadow-mask magnetization will disturb the convergence of the three electron beams inside the tube, and distort picture color.

What magnetizes the shadow mask? Almost any magnetic field that's near the set: electrical machinery, clock motors, even a hi-fi speaker. Moving the set across the room will usually cause the earth's weak magnetic field to magnetize the thin steel mask.

The degausser kit is made by Colman Electronics, Box 2965, Amarillo, Tex., and costs $14.50. It includes two degaussing coils (one for each side of the picture tube), a thermal switch that applies power to the coils for a few seconds when the set is warming up, and all necessary mounting hardware. The manufacturer suggests that the installation be done by a qualified TV serviceman; it's a simple job, but an amateur is likely to disturb the critical beam-convergence adjustments when mounting the coils.

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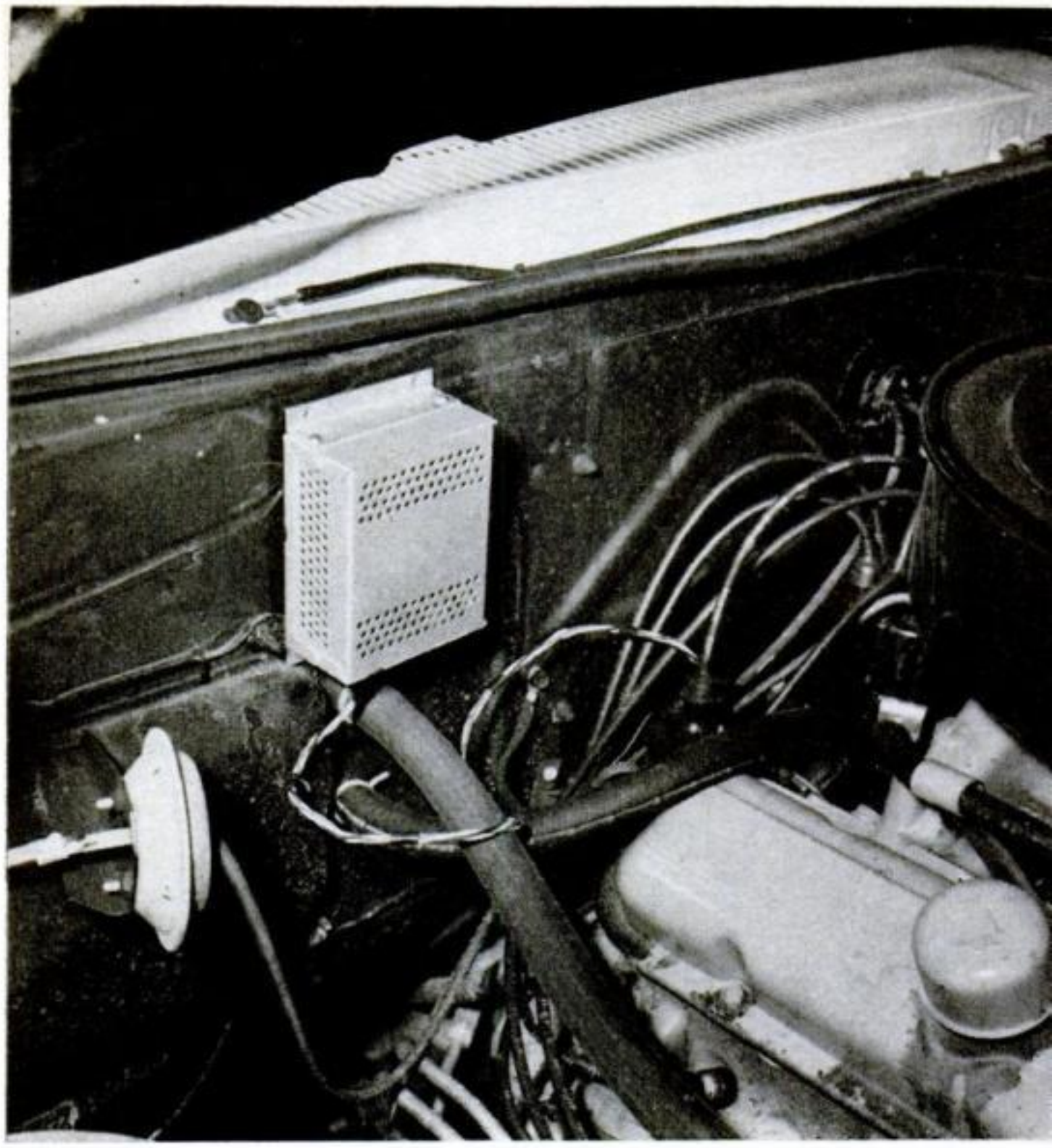
PS ELECTRONICS



High on the firewall is a good spot to mount the C-D-ignition-system chassis. Position it close to the distributor and ignition coil. Choose a location away from engine hot spots such as heater hoses or exhaust piping, and where the case won't be exposed to rain or road splashes. Make mounting brackets from 1"-x-1" aluminum angle. Use self-tapping screws to fasten them in place.

Build your own

Capacitor-Discharge

Here's how to fit out your car with a super-performance ignition system for only $25

WHAT'S so special about a capacitor-discharge ignition system? Many automotive engineers believe it outperforms all other systems used today on passenger cars—including transistor units. Here's why:

- The high voltage generated to fire the spark plugs remains at a constant value—slightly over 20,000 volts—independent of engine r.p.m. By contrast, the output voltage of a conventional system drops sharply at high engine speeds.
- The voltage-pulse rise time—the tiny fraction of a second required for the voltage at the spark plug to rise from zero to close to its maximum value—is so short that the C-D system will fire fouled plugs.
- Contact-point wear is negligible, since points switch less than ¼ ampere. You will have to check point gap occasionally, though, since mechanical wear of the point's rubbing block will change the gap width.
- The system is very efficient—maximum battery drain is about one amp.

What do these things mean to you? Your

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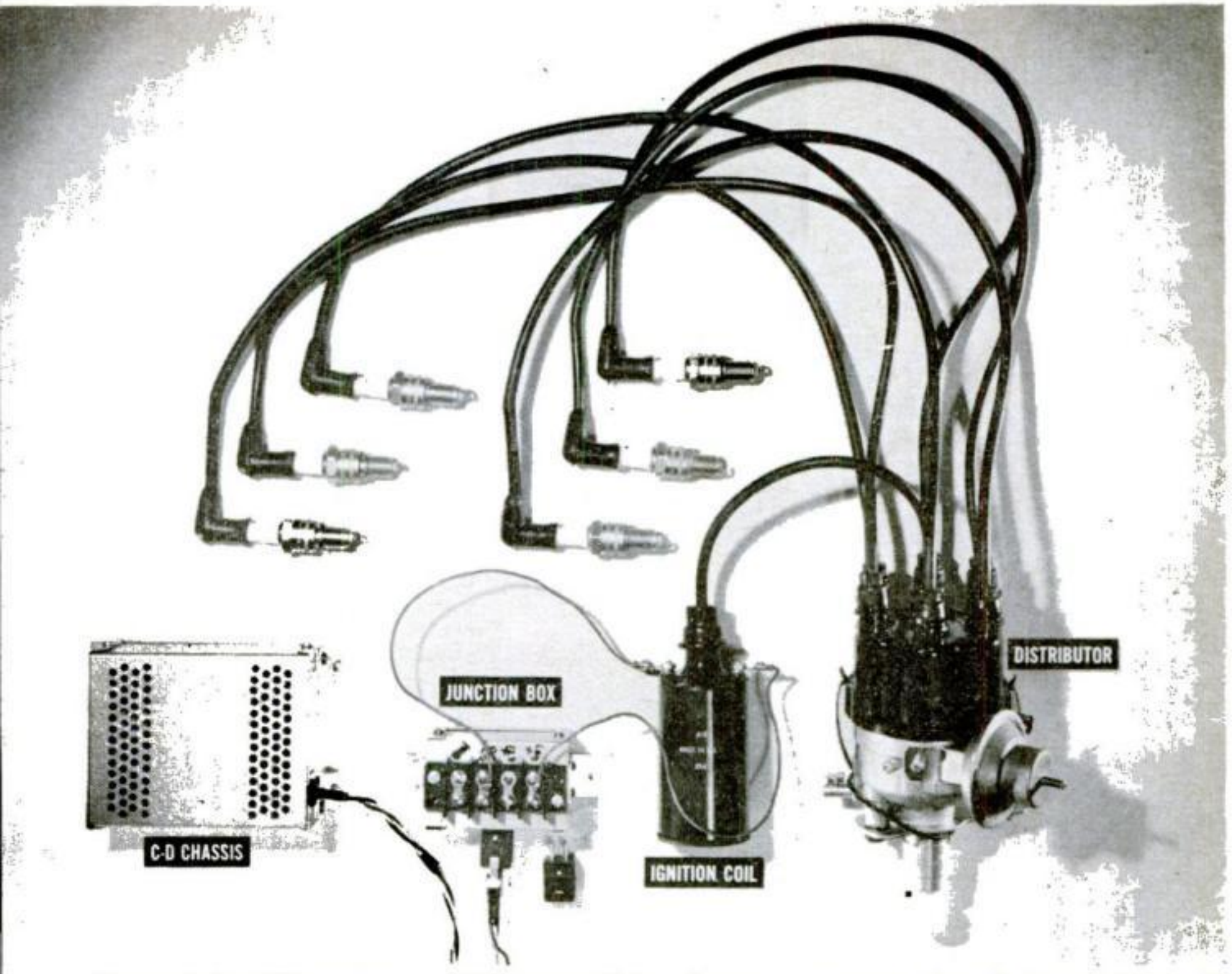


Heart of the C-D system is a silicon-controlled rectifier (SCR)—an electronic switch that discharges a capacitor through the ignition coil's primary winding to generate every spark.

Ignition System

By Howard G. McEntee

car will probably perform better with a C-D ignition system. In tests at General Electric's Semiconductor Products Dept. (which cooperated with P S in designing this system), engineers found that the system boosted high-speed acceleration and gave improved gas mileage.

How it works. The C-D system contains all of the components of a conventional system—distributor, points, and ignition coil—plus a transistorized high-voltage DC power supply, an energy-storage capacitor (C1 on the schematic diagram) and an electronic switch (the silicon-controlled rectifier, or SCR, on the diagram). In operation, the power supply charges C1 to about 220 volts DC. Each time the distributor contact points open, the SCR is triggered "on" —it acts like a closed switch—and shorts the charged C1 across the primary winding of the ignition coil, suddenly discharging C1. The transformer action of the coil generates a 20,000-volt pulse in the coil's secondary winding. Almost immediately, the SCR turns "off"—acting like an open switch—and C1 is recharged to start the cycle again.

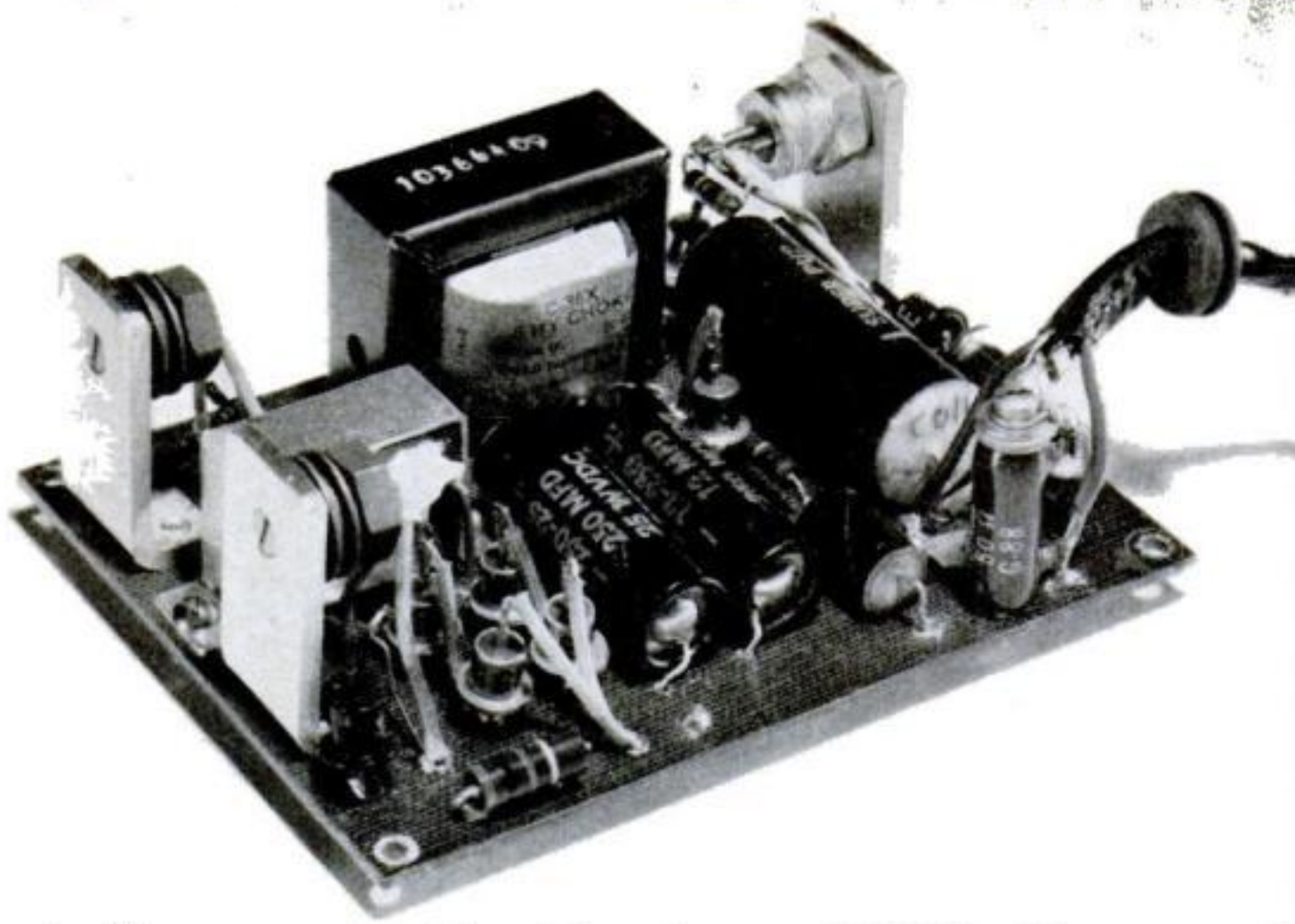
Building it. All components except transformer T1 and choke Ch1 are off-the-shelf items; you must wind T1 yourself, and slightly modify an existing choke to make Ch1. T1 consists of two tiny E cores and

CONTINUED

Urheberrechtlich geschütztes Material

The C-D's guts: a neat chassis

Make sure the heavy parts are solidly bolted down. Mount the transistor heat sinks with homemade brackets. Don't use much force when mounting the SCR; its stud is soft copper. Note: Resistor R3 must be connected across the top terminals of the SCR with the shortest possible leads. Be sure you twist together the two wires leading from the SCR terminals to the chassis board.



a nylon bobbin (see parts list), and a homemade scrap-aluminum mounting clamp (see diagram of bracket and a pattern detailing the lead holes you must drill). There are four windings on the bobbin; #4 is closest to the bobbin center. The black dots on the schematic diagram indicate the start of each winding; make sure the windings all go in the same direction.

Winding #4 consists of 140 turns of No. 28 enamel-covered magnet wire wound in five uniform layers. Wrap the finished winding with a single layer of thin insulating tape.

Windings #2 and #3 are identical, and wound in "bifilar" fashion, over winding #4. This means they are wound side by side. Each has 9¼ turns of No. 20 enamel-covered magnet wire. After they are both wound on the bobbin, the end of #2 is soldered (outside the bobbin) to the start of #3, to make the transformer's primary-winding center tap. Count the number of turns; it is critical to correct operation. Cover the windings with a layer of tape.

Winding #1 is 9½ turns of No. 28 enamel-covered magnet wire.

Assemble the transformer by clamping the two E cores together, face to face, with the wound bobbin on the center arm.

To make Ch1, modify the choke specified in the parts list: Pry the bottom lugs loose, spread out the mounting clamp, and remove the core and winding. You'll find several layers of gray paper between the E and I core strips; remove these, and replace them with a strip of 1/32"-thick cardboard. Reassemble the choke and bend the bottom lugs tight again.

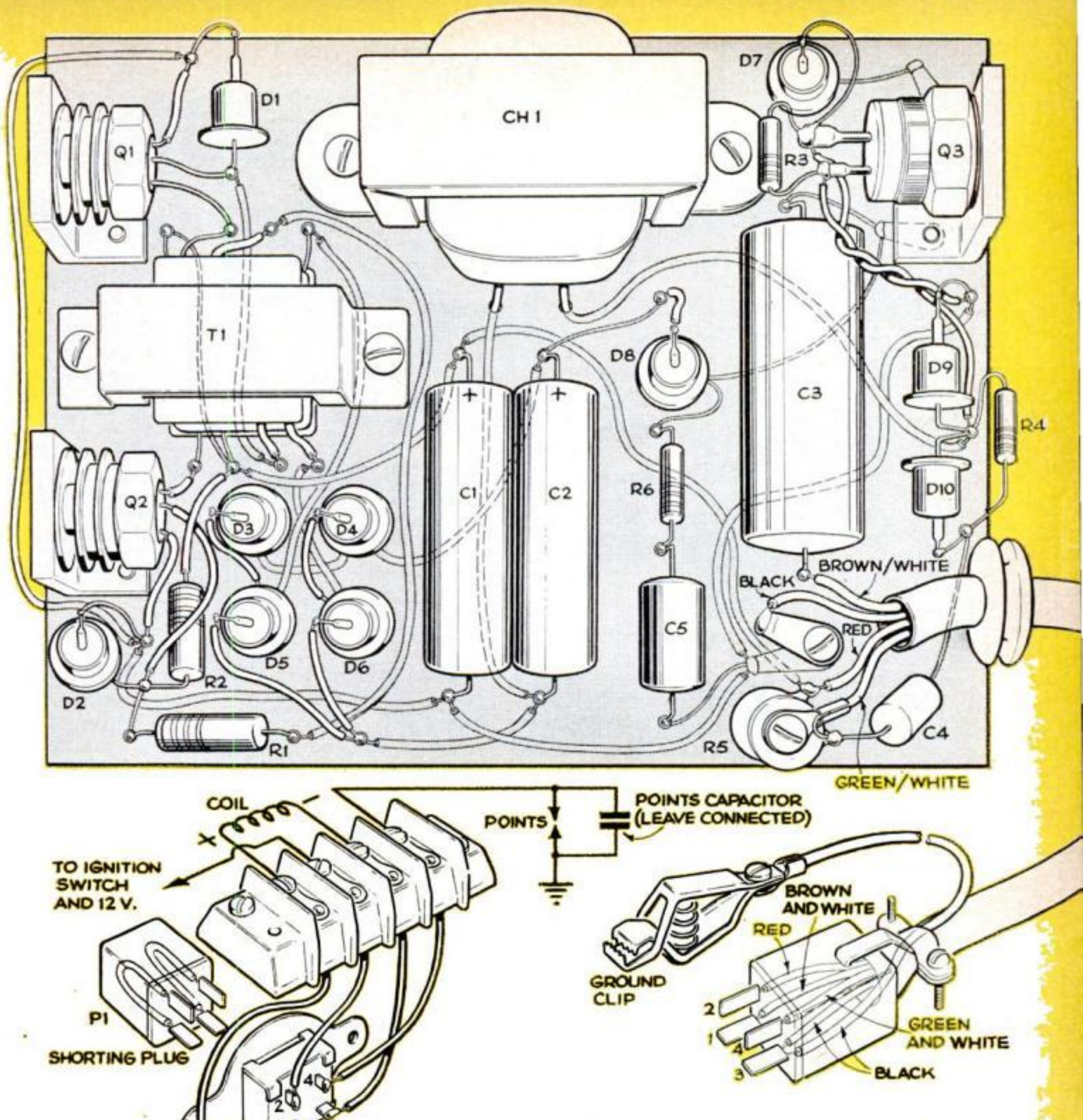
The circuit is assembled on a small sheet of thin fiberboard. Use 3/32" eyelets inserted into drilled holes as soldering points.

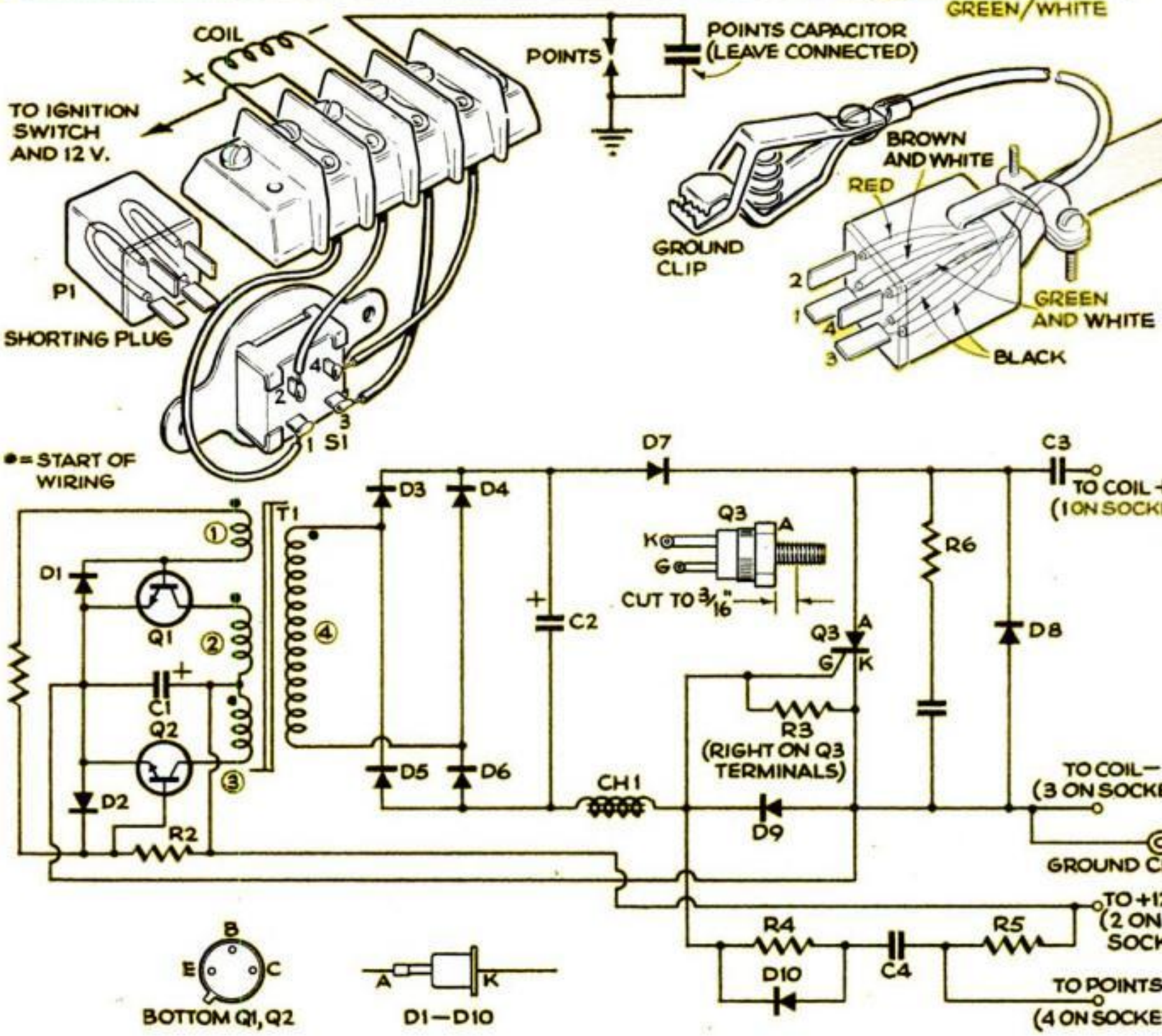
[*Continued on page 188*]

PARTS LIST

R1—100-ohm, 1-watt, carbon resistor
R2—5,600-ohm, 1-watt, carbon resistor
R3—100-ohm, ½-watt, carbon resistor
R4—22,000-ohm, ½-watt, carbon resistor
R5—50-ohm, 8-watt, wire-wound resistor
R6—10-ohm, ½-watt, carbon resistor
C1—250-mfd., 25-volt, electrolytic capacitor
C2—12-mfd., 250-volt, electrolytic capacitor
C3—1-mfd., 600-volt, paper capacitor
C4—0.1-mfd., 200-volt, paper capacitor
C5—0.033-mfd., 600-volt, paper capacitor
Q1, Q2—NPN transistors, type 2N2868 (GE)
SCR—silicon-controlled rectifier, type C20D (GE)
D1,D2,D9,D10—1N536 diodes (GE)
D3-D6—1N1693 diodes (GE)
D7, D8—1N1695 diodes (GE)
T1—see text—assembled from 2 Ferroxcube No. 206F440-3C5 E cores and a No. 595F425 nylon bobbin
CH1—see text—modify a Triad C36X choke
Heat sinks—Thermalloy No. 2210B heat sinks
Misc.—4-prong Jones plugs and sockets; aluminum miniboxes; Formvar magnet wire (No. 20 and No. 28); hardware.

Urheberrechtlich geschütztes Material





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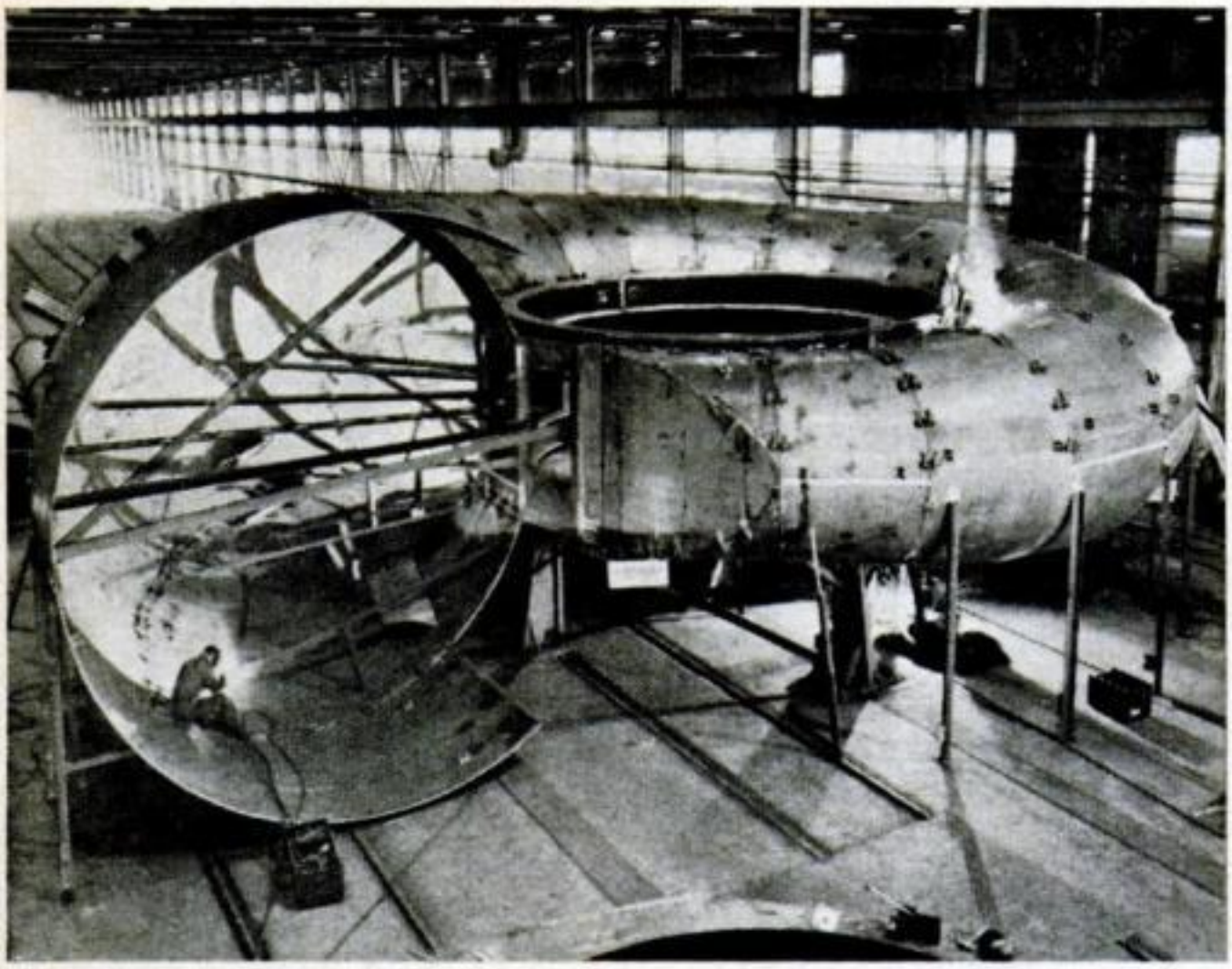
Novel stern-wheeler on Canadian river

Newest riverboat out of Edmonton, Can., is the Little Klondike Queen. A modernized copy of the Mississippi stern-wheelers, the steel-hulled craft is powered by a 130-hp. diesel driving a hydraulic pump that in turn drives two hydraulic motors, one on each side of her 11-foot paddle wheel. The Queen is 50 feet long without her forward loading ramp, has a 15-foot beam, 18-inch draft, speed of 9 m.p.h.



Snail-shaped casing for a big turbine

Water pounding at 49,000 gallons a second through the curled, steel-plate casing at left will help furnish power for eastern Canada. It's one of five built by Canadian Allis-Chalmers for five 82,000-hp. turbines for the Manicouagan hydroelectric project [see Feb. PS] 500 miles northeast of Montreal.

The inlet, shown with a welder inside, is 21 feet in diameter. The diameter of the entire casing is 57 feet.

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How Hams Track Space Shots

Amateurs operate a cut-rate tracking station where everything comes cheap—but results

By Robert Gannon

IN A chemistry laboratory across the street from Cleveland's Thistledown Racetrack, a team of scientists of the Standard Oil Co. of Ohio (Sohio) run the best homemade satellite tracking station in the world. Using ordinary ham radio gear, they make such accurate observations that hundreds of newspapers and broadcasting stations

CONTINUED

Yagi directional antenna is adjusted on roof of tracking station by Roy Rankins of Sohio staff. It has a 50-500-megacycle span.

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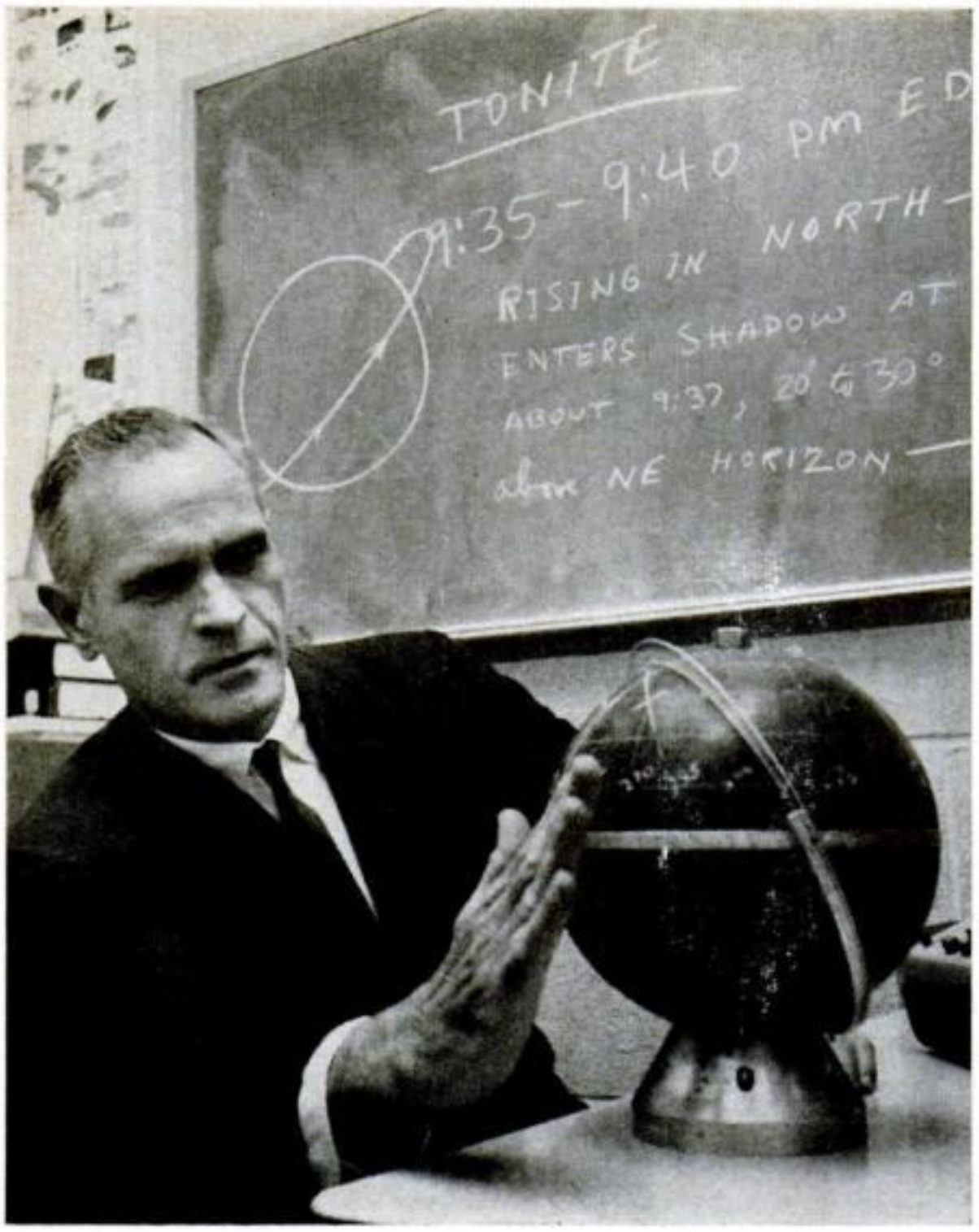
Hobbyists prove you



Dr. A. L. Jones demonstrates the use of simple, home-made satellite "slide rule" for predicting orbits at early stage. Sohio group made the instrument out of a bowling ball.

Monitoring a Russian satellite is Ralph W. Burhans, far right, who originated the tracking station. Dr. Jones, standing, and Tom Petrie, another member of the tracking team, assist him.

frequently look to the do-it-yourself trackers for the first reliable news of American and Russian space shots.

The confidence usually pays off. The Sohio Satellite Tracking Station (SSTS) was the first to determine the orbits of Echo I, Explorer VIII, and Courier I. Its predictions of Echo I and II sightings are regularly printed by nearly 150 newspapers in the Ohio and Western Pennsylvania area. And, perhaps most important, it has developed a method of determining the weights and orbits of satellites from a single listening post, eliminating the need for the usual multiple receivers.

The reliability of SSTS is even more remarkable when you see the equipment the observations are made with. Aside from a 28-foot dish antenna squatting near the lab, and an IBM computer occasionally borrowed from the statistics department, the station is equipped with a host of do-it-yourself items. The radio gear—two VHF receivers, a few frequency converters and signal generators, some tape and pen recorders and graph makers—fits into a space hardly larger than a good-size closet. Except for the absence of transmitters, the place looks like a ham's radio shack. And essentially, that's what it is.

The ham usually found with his ear on space is Ralph W. Burhans, who has a tendency to refer to the equipment as his.

Not surprising, because the whole thing was his idea in the first place. That was back in 1956, when the notion of satellites whizzing around the earth first began to look like a possibility. Burhans (W8FKC), who already had the basement of his ranch-style home near suburban Chagrin Falls full of radio equipment, thought of building a poor-man's satellite tracker. But who would monitor the space waves during working hours?

On the offbeat chance that his employer would go for the idea, he suggested that some of the unused space in Sohio's new research building might be set aside for his equipment.

"It was an interesting idea," recalls his boss, Sohio's Dr. A. Letcher Jones, 49, a distinguished, former Cornell University chemistry professor.

Then came Sputnik. Dr. Jones passed the request on up the ladder. For a full

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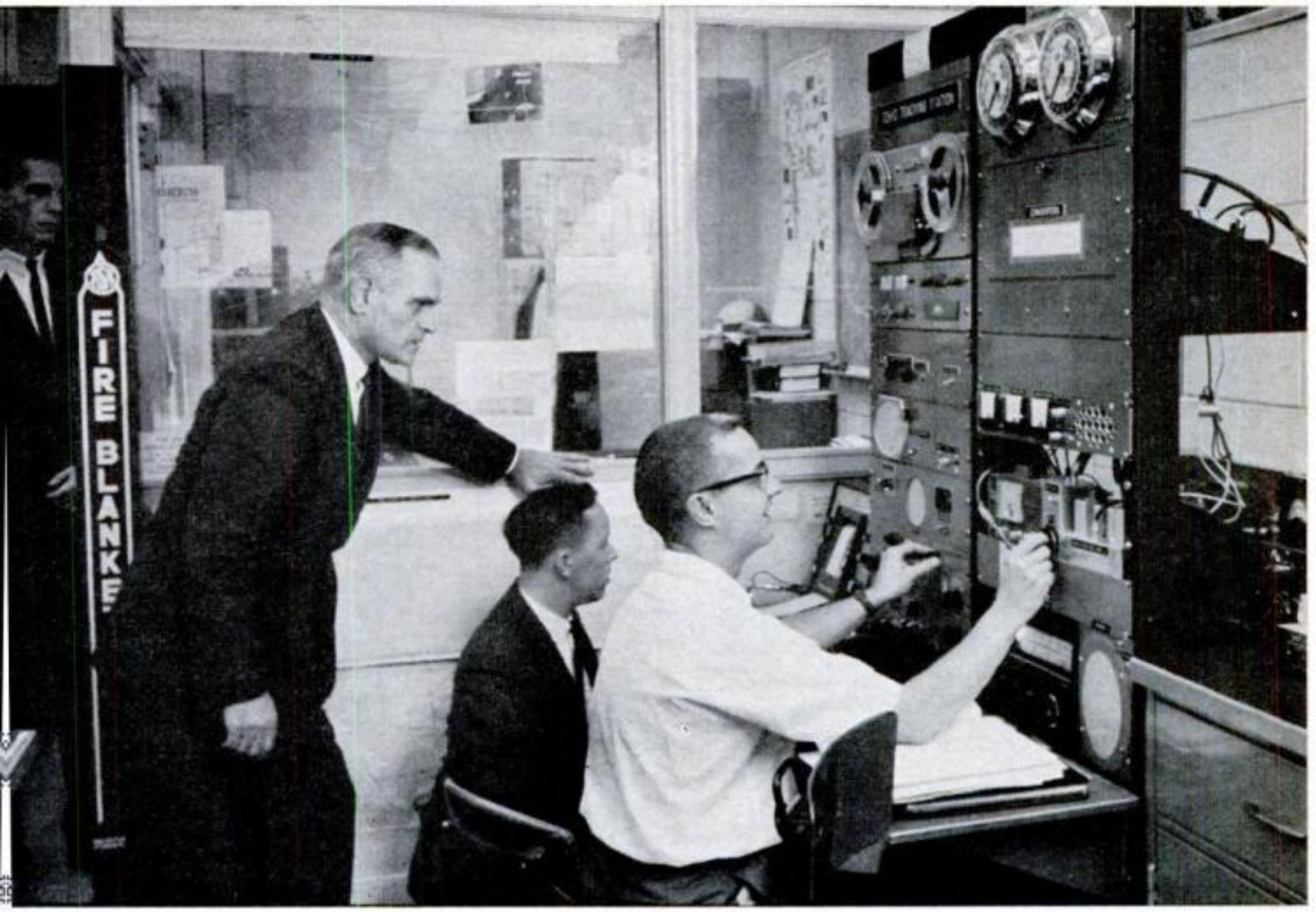
can track satellites with ordinary ham equipment



year, though, no action was taken. And then Sputnik I shocked the world into space-consciousness. "The very next day Burhans came to me with a pen amplitude recording of Sputnik's signal, made in his basement," said Jones. "That shook us loose." In November, 1957, the go-ahead came through.

Sohio made a small grant for equipment, and Burhans, Jones, and half a dozen others pitched in to build the station in time for America's launch of Explorer I.

On Jan. 29, 1958, the station was finished.

"But when we were through," said Jones, "we really couldn't tell if it would work or not. Sputnik I, which had inspired us to build it in the first place, had fallen back to earth. Sputnik II was still in orbit, but its radio was dead."

Then, just two days after the installation was completed, Explorer I was launched. "We picked up its signal the first time it climbed above the horizon. It was a beautiful sound."

Russian tuned in. An even more exciting sound was experienced on Aug. 6, 1962, the day of Soviet Maj. Gherman Titov's 25-hour space flight. At first crackley, then clear, telemetered data of the respiration and heartbeat of the cosmonaut sounded over the loudspeaker. And suddenly, startlingly, a man's voice speaking in Russian: "I am Eagle. I hear you very well . . . Thank you for the congratulations. How are you receiving me?" He was speaking to the Russians' Atlantic tracking ship, Spring II.

Dr. Jones called a friend at a local radio station, played Titov's tape, and the station put it on the air. Almost immediately a Russian Orthodox priest, the Rev. Andrew Chernushin, phoned with a translation.

Since then, the men of SSTS have tracked every major satellite—even recording the Ranger VII moon photos.

CONTINUED

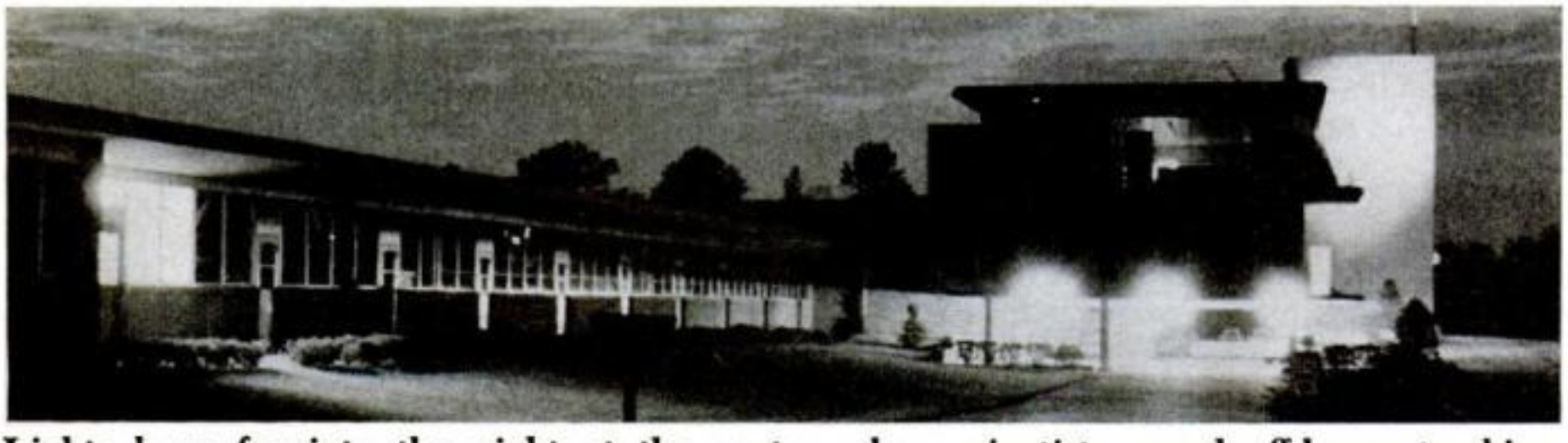
Urheberrechtlich geschütztes Material

Probable paths of satellites are plotted by Dr. Jones and Dr. D. S. Fay. The actual orbits are then confirmed by radio observation.

The Sohio scientists use their equipment to determine these basic characteristics:

- *Spin rate.* Many satellites have directional broadcasting antennas. When an antenna is in line with the receiver, the signal is clear; when it is turned away, the signal is low. Variations in intensity give the spin rate.
- *Orbital period and velocity.* This is found simply by recording a satellite's Time of Closest Approach (TCA) on successive orbits. TCA (like most other basic measurements) is located by recording a satellite's Doppler curve—the change in radio-wave frequency as the transmitter passes an observer—similar to the pitch shift—*eeeeoooo*—of a bullet as it whizzes past. You make a pen recording of the Doppler shift as the satellite passes; where the curve drop is greatest, that's the TCA.
- *Lifetime.* The minimum practical orbit time is about 88½ minutes—close to that of our manned Mercury flights. When the Sohio trackers find a satellite's orbit period, they quickly compute the altitude, determine the small amount of air resistance at that altitude, along with orbit "ovalness" and rate of change, and, subsequently, how soon the atmosphere will burn it up. When any satellite's orbit time drops below 88 minutes, its life can be measured in days.
- *Size and weight.* These are determined by analyzing atmospheric drag and optical brightness (through use of a government-surplus aerial camera), compared with the known brightness of background stars.

The Sohio deductions don't depend on complex equipment. And this, perhaps, indicates why no other outfit is quite like SSTS. "Why has nobody else done this? The clue, I think," said Dr. Jones, "lies in our finding that you don't need huge investments in order to make good measurements, and that talent is more important than equipment. We are lucky in that our people have diverse interests. Most of us are primarily chemists, but on the tracking team we have people interested in mathematics, physics, electronics, and astronomy. By combining talent with simple equipment, you can make useful contributions; and you can't help but generate excitement. ■■



Lights burn far into the night at the center when scientists spend off-hours tracking.

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Camping in a covered wagon

Latest in tents for family camping, the Prairie Schooner, is shaped like a covered wagon. Made of waterproof drill, it's held up by fiberglass ribs. Poles support awnings at the ends. Front and back have screened windows with zippered rain flaps. The door closes with a zipper. King-Seeley Thermos, Norwich, Conn., makes 9- and 12-foot models at $124 and $156. Both have sewn-in ground cloths.

Drilling for oil in the North Sea

Shown drilling off the coast of Holland, the California Texas Oil mobile derrick above has now been towed to Dogger Bank, an 85-foot-deep shelf of the North Sea, 150 miles from Sunderland, England. Its self-lowering legs, on which a heliport sits, are 175 feet long. A crew of 40 commutes from Sunderland by helicopter.

Hospital bed acts like space capsule

Once the aluminum lid and plastic bubble are latched on this bed, the patient in it lives in his own little world of oxygen like an astronaut going to the moon. London's Westminster Hospital is testing it for heart sufferers and other patients, forcing into their blood and tissues 15 times more oxygen than normally breathed.

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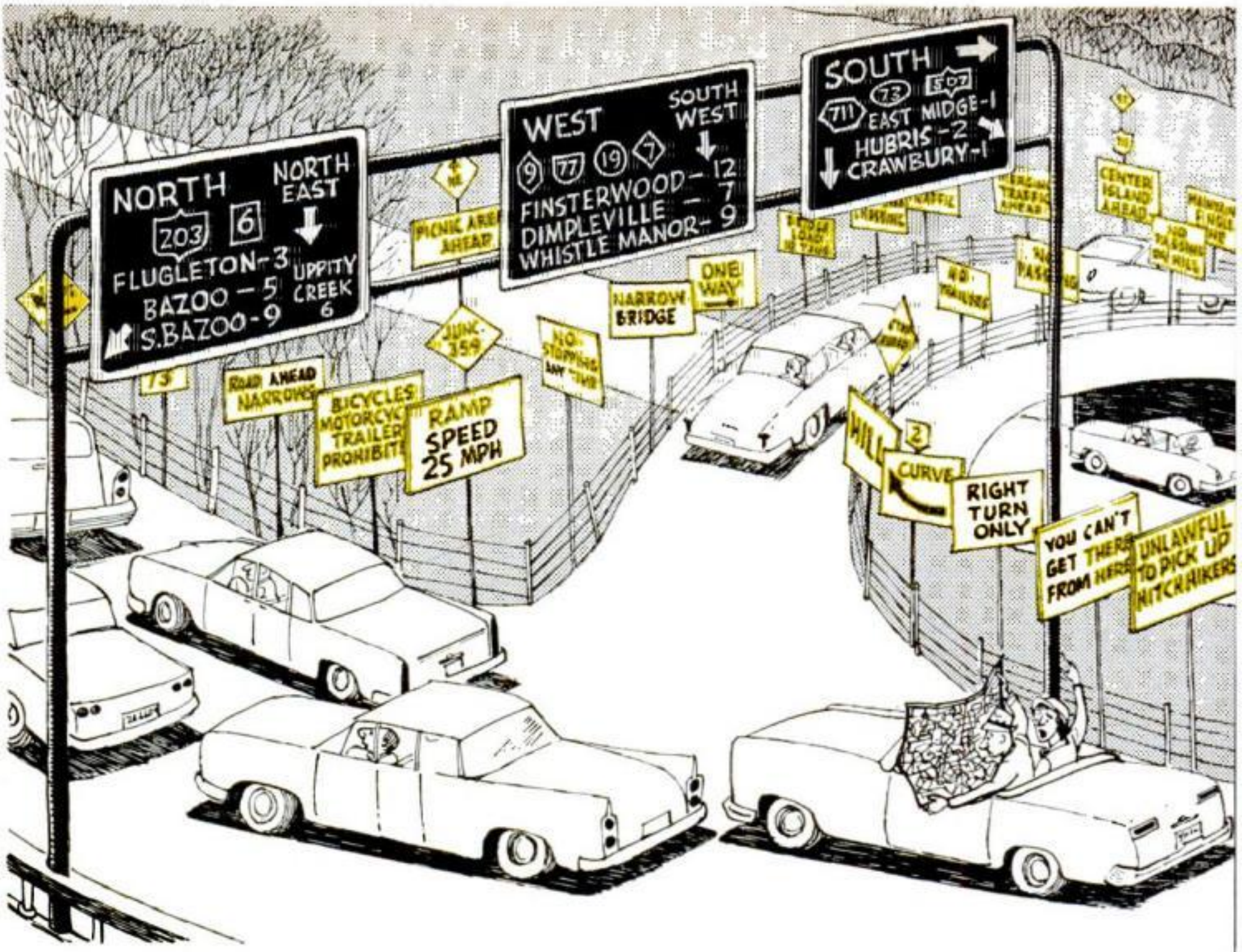

Stupid Highway

By Leon D. Adams

EVERY hour of every day, on almost every road and street in the country, stupid signs are confusing motorists and leading them dangerously astray. When road signs don't make sense, the driver always hesitates—and a hesitating driver is a hazard.

For us millions of drivers who often lose our way in today's growing maze of streets and highways, it may be consoling to know that science, at last, is tackling the problem of ambiguous traffic signs. Teams of researchers are at work on this most common of highway annoyances—the cause of angry miles of extra travel and uncounted numbers of crashes. These scientists have come up with major improvements in road-sign language. A wholesale replacement of signs is under way in all states and most cities.

A campaign is now on, with a Jan. 1, 1968, deadline, to make road signs everywhere conform to new national manuals. The U.S. Bureau of Public Roads offers money to states, cities, and counties for completing the changeover to conforming signs on their federal-aid roads and streets by that date.

Dr. Slade Hulbert, working in UCLA's Institute of Transportation and Traffic Engineering, began the first American research on sign understandability—the

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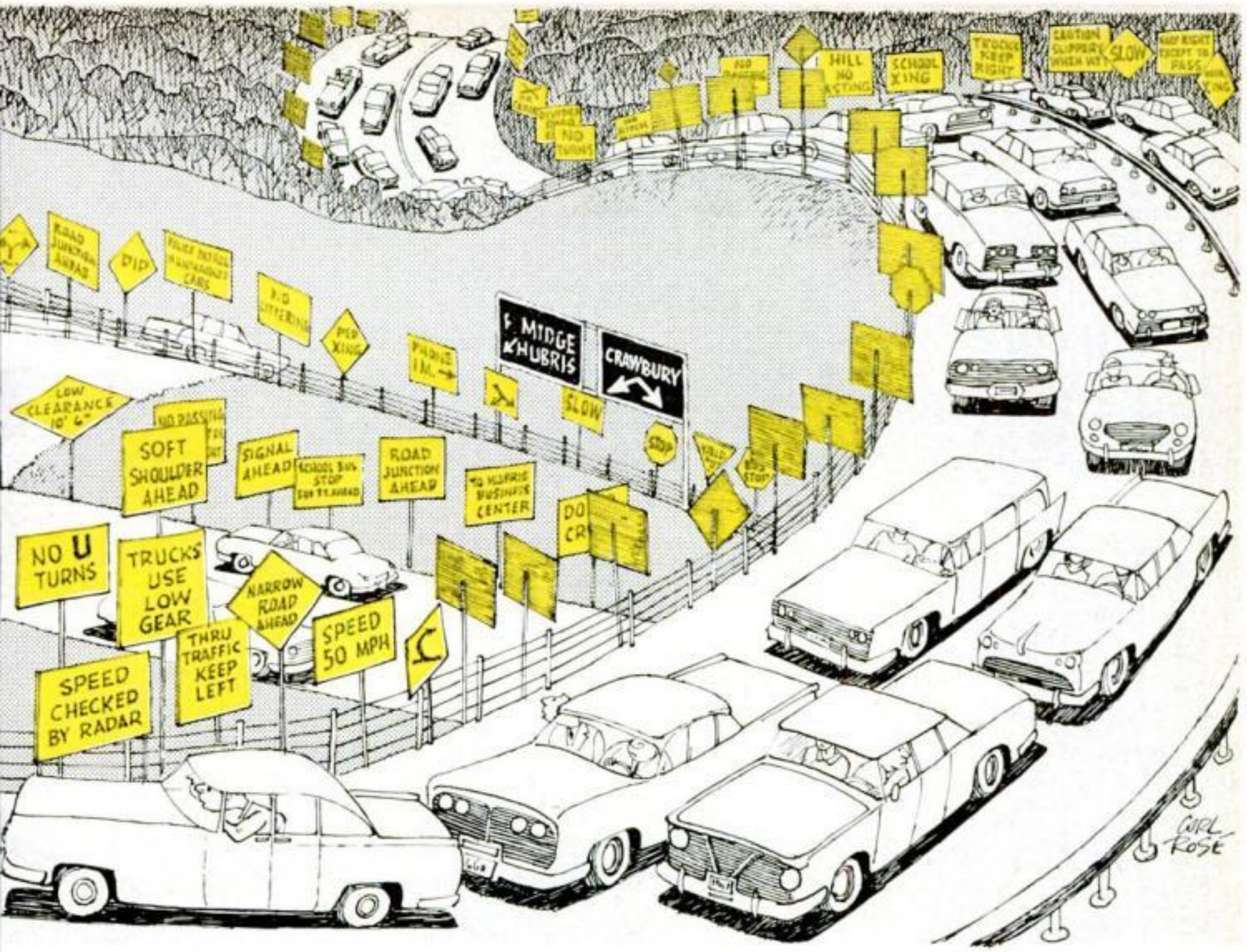

Signs Can Kill

first scientific probing of the psychology of giving and following directions. He calls his work "directionology—the science of how to get there from here."

A balding, intense 42-year-old gadgeteer, Hulbert heads a crew of investigators who put motorists behind the wheel of a speeding sedan on a treadmill—the latest advance in driving simulators. Before his eyes, the driver sees movies of the road ahead, projected on a semicircular screen. The scientists

CONTINUED

Normal "do not enter" signs on one-way exit ramps do not prevent accidents. This sign, aided by red flashing lights and loud horns, was an improvement. But what proved even more effective was the white arrow on pavement.

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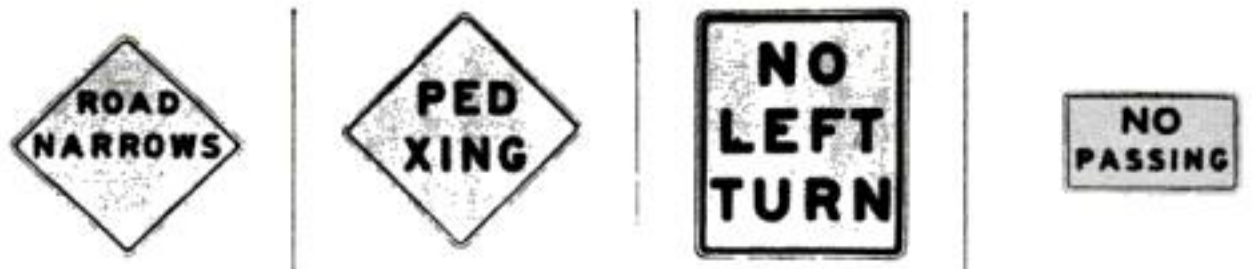
The driver can recognize and understand symbols in a flash,

In the U.S.

Text signs are often slow to read, sometimes less easy to understand, and no more informative than symbols.



In Europe

Theoretically symbols need interpretation — in practice they have proved easy to memorize by association.

record how each glimpse of a road sign affects each driver's efficiency. They also measure his pulse rate, breathing, and emotional tension, all of which are affected every time he studies a puzzling sign. Their discovery of ways to reduce our motoring miscues has led to many of the sign changes you now see in progress.

Hulbert's pioneering studies have inspired other research groups in this country and abroad to take up directionology. Words on signs are being reshuffled, many words are being dropped as superfluous, all-capital-letter names are being changed to upper and lower case because tests show they can be read a split second faster, and signs that once were white, black, or blue have taken on a new color called highway green (although the latest research indicates that blue, used in Europe, would have been still better, as green tends to blend with background foliage). In addition, whole highways are being renamed and renumbered to reduce motorist confusion.

"But these are only the beginnings," says Hulbert. "What we face is a problem in high-speed semantics. In the early days you could stop and read signs at crossroads. Now, with cars traveling up to 100 feet a second, you must know before reaching the intersection which way to go. When you lose your way, your anger and worry tend to make you a dangerous driver. A moment's hesitation or a misread sign can

Drivers need precise warning about lanes that disappear

"Squeeze left" sign is impossible to read at a distance and does not tell the whole story. Sign in the middle is complete but takes time to read. The line-and-dot drawing at right must be explained before it can be understood, but once familiar, it should convey its message as clearly as the zigzag line that indicates a winding road. Both are now common on U. S. highways.

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but he needs time to read and think about text signs

cost a life. What we need are symbols that deliver their message instantly and that actually trigger your driving reflexes, signs that give you confidence that you really are where you think you are and that you're headed where you want to go."

Verbalize or symbolize? This is a question Hulbert constantly ponders. In 1951 the United Nations urged this country to adopt Europe's international road signs. These consist of 49 symbols, only three of which use words (stop, hospital, and customs). U.S. highway officials of five states conducted elaborate tests of the symbols, but American drivers' reactions to them were predictably erratic, since no attempts had been made to teach the motorists their meanings. The recommendation was rejected.

However, most Americans who drive cars in Europe come home with praise for the international symbols. Last year Hulbert traveled for five months in Europe and liked their road signs.

"Symbols," he says, "express their meaning in a flash. They overcome language barriers and illiteracy. Symbols might compete better for drivers' attention in today's jungle of road signs, all expressing their messages in words."

The most popular symbol used in this country is the "wiggleworm" curve sign, which two years ago acquired an additional wiggle to warn of multiple curves, and replaced the "winding road" signs.

Why do we lose our way? The Automotive Safety Foundation, worried by

CONTINUED

Which is the main road and how does it turn?

Italian road sign does not tell how far it is to Siena, but it shows the distance to the turn (150 meters), the exact nature of the turn, and the junction with a secondary (narrow) road.

California sign gives the distance to the towns, but tells the driver nothing about whether he is approaching a main road, a road fork, an intersection, or two separate side roads.

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Early warning for exits on the N.Y. State Thruway are given a mile before turnoff, and most exiting cars are in the exit lane before the quarter-mile warning sign comes up.

the mounting accident rate, volunteered to help Hulbert and his associate, Dr. Albert Burg, in their first major study of why we lose our way on the highways. Nearly 12,000 motorists were stopped and quizzed. One in 10 said they were having trouble finding their destinations. One in three had *felt* they were on the wrong road at least once since leaving home—and one in six actually *had* been.

This lost-driver study, published in 1960, jolted the traffic engineers of the nation. In California alone, embarrassed highway officials rewrote and replaced hundreds of signs that the researchers had found to be confusing. The study developed four new basic principles for directional signposting. The signs must: 1) Reassure the driver by frequently telling him where he is, 2) give repeated advance notice of exits ahead, 3) offer only the simplest alternatives, and 4) foresee natural driving mistakes in order to prevent them.

These principles have been adopted by the American Association of State Highway Officials and the National Joint Committee on Uniform Traffic Control Devices, two of the organizations that write the national uniform sign manuals.

When your lane ends. One Hulbert project from some years ago is a classic example of problems in sign semantics. He was testing the signs that warn you of a "lane drop"—the perilous situation where the pavement ahead narrows and your lane disappears. State highway officials asked Hulbert to determine which works best: California's sign, which reads "LANE ENDS—MERGE LEFT" or New York's sign, which reads "SQUEEZE LEFT," or a "chimney" symbol (see drawing). The tests showed that "merge" meant more to motorists than "squeeze," that "eeze" in capital letters looked like a solid bar from a distance, and that few drivers understood the chimney merge-left symbol.

Hazards of one-way traffic. One hazard that still remains is the danger of entering a one-way exit ramp the wrong way. The "do not enter" signs at freeway exit ramps fail to convey their grim message to some motorists. Result: hundreds of accidents.

Hulbert recently experimented with "do not enter" signs of four different shapes and colors. None of the signs worked to perfection: One out of 12 drivers sped on past the warnings.

Results with a series of signs explaining the situation in step-by-step fashion have not been encouraging. The best success so far has been obtained with

[*Continued on page 183*]

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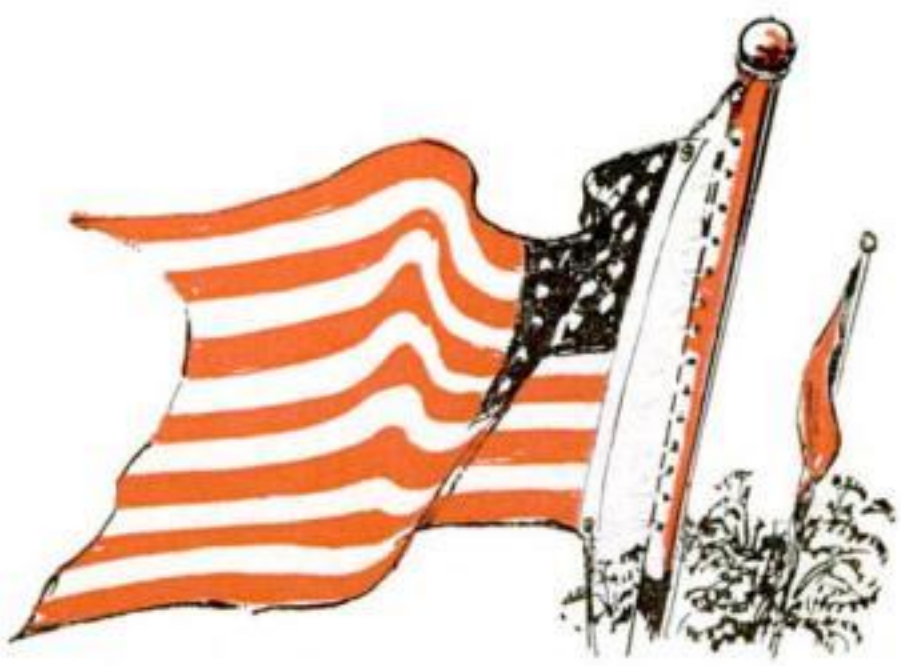
"I'd like to see them make..."

A satchel stool for weary camera-toting tourists, fair-goers, and parade watchers. The satchels would hold accessories and extra film.—*L. H. Kwong, Oxford, Ala.*

A boxlike trunk add-on for compacts, as an option. Its door would open upward for easy loading of extra luggage or camping gear.—*Todd Jaffe, Washington, D.C.*

Allen wrenches with flat surfaces on the *sides* rather than the top. Then you could use a wrench on them when working in tight spots.—*J. H. Hirrlinger, College Park, Md.*

Wheelbarrow outriggers so one person could handle a top-heavy load with no tipping. The wheeled attachments would be adjustable for width.—*Chris Aiello, Killingworth, Conn.*



A breeze-producing flagstaff. Air pumped through a hollow pole and out through holes at the top would keep a flag waving even on calm days.—*R. C. Hubbard, Westminster, Md.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's *yours?* We will pay $5 for each one published. Please use Government postcards only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 10017. Write your name and address clearly. Contributions cannot be acknowledged or returned.

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Test boat was a 19-foot fiberglass Wellcraft Model R-2000. At left, it is rigged with twin

Are Two Outboards

To get the answer, a special test was set up by Popular Science. Here are the results

By Jim Roe

HOW many motors should the well-dressed outboard wear? Whenever the total power on the transom climbs up toward the hundred mark, outboarders begin to weigh the advantages of single- vs. twin-motor installations.

The answer to this question is always an individual one. It is based on a mixture of economics, engineering knowledge, and personal preference. It's easy to see that one motor costs less than two and weighs less than two, for the same horsepower. Conversely, it is easy to see that two motors give you twice the safety and convenience protection against an offshore power failure. And, while some folks like the simplicity of a single lever at the control station, some of us just plain enjoy pushing throttles—and the more throttles there are, the better.

Surprisingly, there is very little engineering data on the performance and economy of one motor vs. two. So POPULAR SCIENCE decided to set up a special test to get some facts for you. The test was performed on an accurately surveyed course and was supervised by trained engineers of the Kiekhaefer Corporation. Basically, the tests consisted of a series of speed and gasoline-consumption trials, using the same 19-foot fiberglass boat (a Model R-2000 Wellcraft), and varying the horsepower between a single 100-horse Mercury and a twin installation of two 50-horse Mercury motors. A table farther on shows the result.

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50-hp. motors; at right a single 100 hp. Surprisingly, top speeds were almost identical.

Better Than One?

The test engineers were a bit surprised to find very little difference at top speed between the single Merc 1000 and the dual Merc 500s on the Wellcraft. This is not always the case; on some boats, the added drag of the dual lower units will make the 500s slower. On the other hand, some boats have a keel that creates water turbulence ahead of the propeller, and the dual 500 props might show better efficiency by operating at the sides, outside the turbulent area. Propeller-blade area is another factor: The dual 500s, with more total area, might be more efficient in certain applications.

Oddly enough, the 112 pounds added to the Merc 1000 test to equalize the gross load actually improved the top speed slightly. This is another variable that makes for unpredictable results: On some boats, tests show that the added weight will reduce speed.

Fuel consumption in pounds was determined directly by weighing the tanks before and after each 15-minute operating period. One gallon of fuel weighs six pounds, so the conversion from pounds to gallons is simple and accurate. Tests showed little difference in fuel consumption.

CONTINUED

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Average boat speed is determined by stopwatch on an accurately surveyed closed course marked by pylons. In photo above the test driver "hits" the stopwatch just as the bow reaches the finish pylon.

SINGLE MERC 1000 VS. DUAL MERC 500s

on 19-foot Wellcraft Offshore Fisherman, Model R-2000, 89" beam

BOAT WEIGHT

Boat only, no power plant, no payload	1,225 lb.
With Merc 1000 and one person, fully rigged	1,873 lb.*
With dual Merc 500s and one person, fully rigged	1,873 lb.

*112 pounds of payload added to equalize gross load.

TOP SPEEDS

Merc 1000, one person in boat, fully rigged	37.736 m.p.h.
Dual Merc 500s, one person in boat, fully rigged	37.190 m.p.h.
Merc 1000, 4 persons in boat, fully rigged	36.660 m.p.h.
Dual Merc 500s, 4 persons in boat, fully rigged	36.364 m.p.h.

FUEL CONSUMPTION (gallons per hour, full throttle)*

Merc 1000, 4 persons	11.33 g.p.h.
Dual Merc 500s, 4 persons	12.0 g.p.h.

*Up to 50% better fuel mileage attainable with Merconomizer fuel-economy linkage when throttle is backed off to most economical cruising speed.

MOTOR COST (electric models with starter & generator)	SINGLE MERC 1000	DUAL MERC 500s
FOB price	$1,255.00	$1,540.00
Dollars per horsepower	$ 12.55	$ 15.40
Weight	246 lb.	312 lb.
Pounds per horsepower	2.46	3.12

From my own standpoint, the biggest surprise of this test was the closeness of the results, both in terms of top speed and in fuel economy. I had expected a single 100-hp. motor to have a decided speed advantage. Actually, the results for both a lightly and a heavily loaded boat were so close as to show no appreciable difference between the single-motor installation and the twin.

The same surprise was in store on the fuel-consumption test. I have always operated my own boat with twin motors, and have often been told I was paying an extremely high price in gasoline consumption for this privilege. However, the test indicated this might not be true. For the difference between 11.33 gallons per hour with a single engine and 12 gallons per hour with two engines is so slight as to make this factor unimportant.

Cost per horsepower. About the only place I found a clear-cut difference is in the price per horsepower. The single-engine installation cost $12.55 per horsepower; the dual installation cost $15.40 per horsepower. This difference of $2.85 per horsepower can apparently be justified only on the basis of personal preference and/or one's desire to be equipped with two motors for offshore boating.

How do these same factors work with other makes of outboard motors? Judging from catalogue information and price lists, single-motor installations seem to be consistently lower in dollars-per-horsepower than are dual-motor installations of about equal total power.

It's more difficult to obtain the comparative figures on speed and fuel consumption, since most other high-horsepower motors do not figure out in handy multiples of one another as do the 50- and 100-hp. Mercs. Some makes would require a comparison of two 40-hp. motors with a single 90-hp., and thus the figures would be thrown off.

A personal preference. The question of one or two motors is, in the final analysis, one each boatman must answer for himself. Personally, I like two motors. My reasoning is very simple: I like two motors for the same reason that airplane pilots like more than one engine. Though today's outboard motors are among the most dependable machines you can imagine, it is a fact that they're subject to accidents and occasional malfunctions. And since I do most of my boating in the Great Lakes, occasionally going clear across Lake Erie to Canada, this twin-unit reliability has always seemed essential to me for a feeling of security. The extra cost seems like pretty cheap insurance against the possibility of a long paddle home. Besides that, I just plain like to shove two throttles forward instead of one. ■■

Urheberrechtlich geschütztes Material

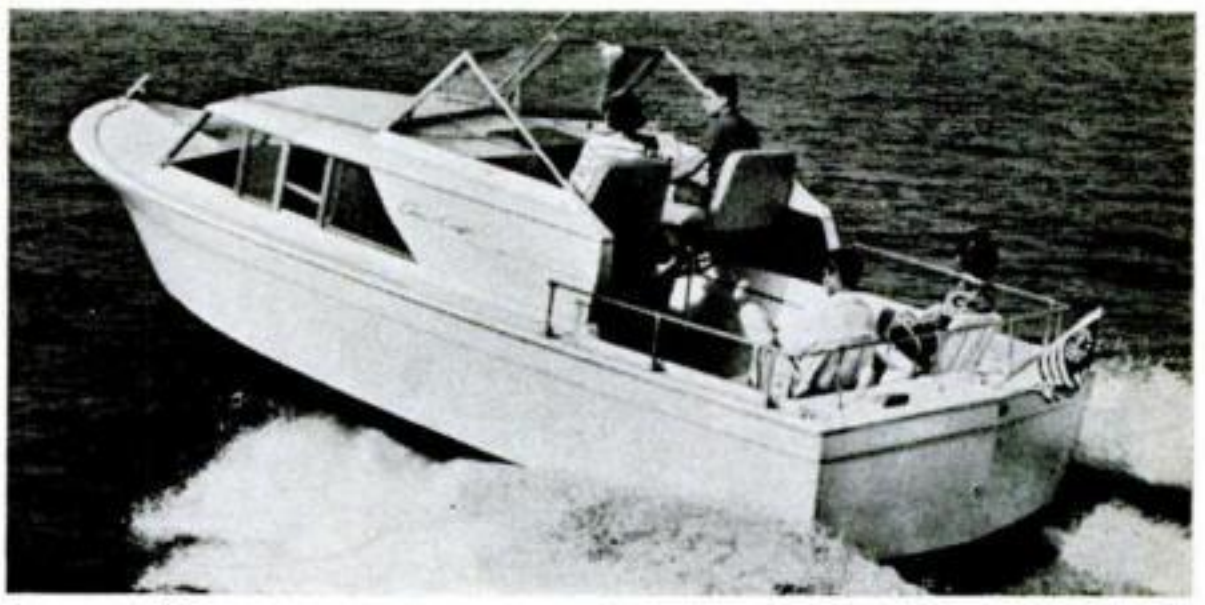
what's new in BOATING

New 16-footer has stern drive

This 16-foot Marchesa—a new hull design—comes with the new MerCruiser 60 stern drive. In proving-ground tests, she's hit more than 30 m.p.h. with four aboard. Fuel economy is said to be so good the boat will run an hour on only a gallon and a half of gas. Price is about $2,400. Winner Boats, Inc., Dickson, Tenn.

A kit for building a sailing cat

Scat-Cat, built from a kit, is 12 feet long, has a beam of 6 feet. Draft is 37 inches with the board down. It comes in wood or fiberglass. According to the maker, sails can be made in four hours without sewing. The boat is said to point well and come about easily. The kit is $222 in wood, $322 in glass. Seafari, Box 1791, Cleveland.



Chris-Craft has new four-sleeper glass cruiser

The 27-foot Commander Express, a new fiberglass cruiser, is one of four Chris-Craft models offered this year. The hull is inset at the chine to deflect spray. The transom is slightly V-shaped, and vertical stabilizers run the entire length of the bottom. Power is a 210-hp. V-8 marine engine. Chris-Craft Corp., Pompano Beach, Fla.

Boat for anglers also serves water skiers

The stamp of approval of northwoods guides is carried by this new 16-foot aluminum Fish and Ski. It has high sides for safety, high-speed performance, and four conveniently arranged bucket seats. The versatile boat has a load capacity of 1,500 pounds and a 75-horsepower rating. Lund Metalcraft, Inc., New York Mills, Minn.

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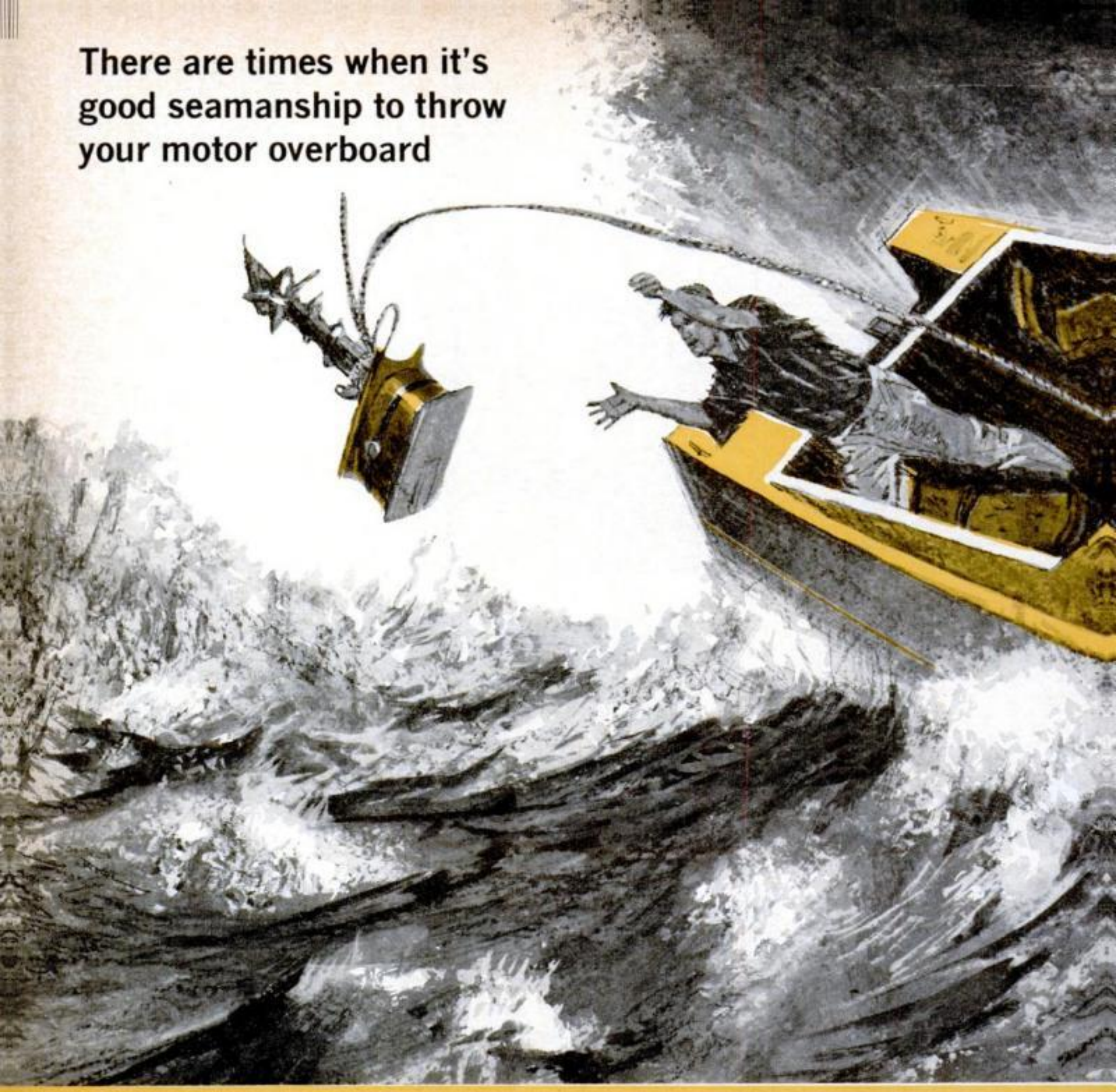

PS BOATING

8 Boating

By Richard Petrow

"IF THE seas were any rougher, that fellow would be in serious trouble," said Coast Guard Warrant Officer Malcolm Versaw. We were perched atop the lookout tower at Shinnecock Inlet on the Atlantic side of Long Island. Far below us, a 24-foot cabin cruiser was easing its way *at minimum speed* through the treacherous inlet.

"He's going as slow as he can," Versaw explained. "Probably thinks he's being cautious and safe. But he's handling his boat in the worst way."

Versaw, a Coast Guardsman for 28

Crises ...and what you can do about them

years, is commanding officer of a group of lifeboat stations. He's served on the Atlantic and Pacific coasts, and on the Great Lakes. He's one of the Coast Guard's most expert boat handlers.

I'd come to visit him at his station on Shinnecock Bay to ask him for practical tips on boat handling. Here, in his own words, Warrant Officer Versaw tells you about eight crises you could run into, and how you should handle them:

1 "Your outboard motor conks out. A storm is blowing you towards a rock jetty. You have no anchor, no oars.

"If you have a flare, fire it at once. Try

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to slow your drift towards destruction by use of a makeshift sea anchor.

"Sea anchors act best when you're being pushed primarily by the wind. But a strong current will carry both your boat *and* the sea anchor along with it. In this case, you desperately need an anchor of some kind.

"It's right there under your nose—your outboard motor. Use it. Tie a strong line to it and heave it overboard, attaching the other end of the line to the bow.

"Suppose your 'anchor' doesn't hold. You're onto the rocks. What now? There's only one action left: Tie the heaviest line you have to some piece of equipment and heave it as far over the jetty as possible, snagging it in the rocks. Then use the line to climb onto the jetty."

2 "You're about to run an inlet. There's no wind, seas offshore are moderate, the tide is with you. You've got nothing to worry about—you think.

"This situation has meant death to many, for two reasons. One: the action

of water in narrow inlets. Regardless of how calm it is offshore, ocean swells build up murderously in inlets. Two: the reaction of inexperienced boatmen—they tend to reduce speed when moving through confined waters.

"We see it every day. A boat will slow down as it approaches the inlet. Almost without warning those 'moderate' ocean swells have built up and are hitting the boat's stern like liquid sledgehammers. Within seconds, the vessel has started to broach and is in danger of capsizing.

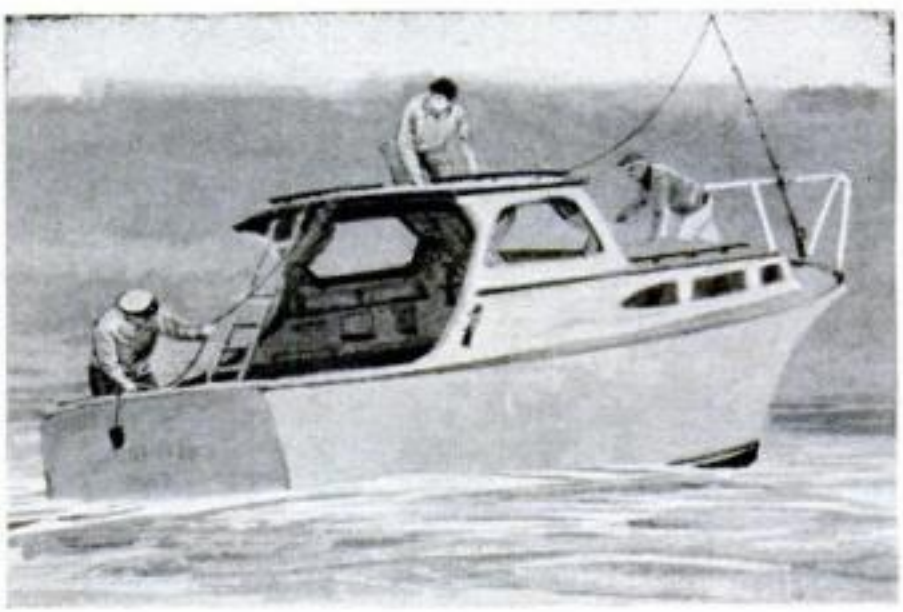
"The rule of thumb for negotiating an inlet under such conditions: Use enough speed for complete steerageway at all times. Don't be afraid to use more speed than would otherwise seem prudent.

"If you start to broach, goose your engine and turn your bow in the direction the stern is being pushed—just as in a skid. If you're already broadside to the oncoming seas, however, the safest thing is to complete the circle and head back out into the ocean.

"Then play it smart. Observe the action of the sea. Swells run in patterns, with five or six large ones followed by a period of relative calm. Make your next run through the inlet during a calm period and make it with power to spare."

3 "You're running for shore trying to beat an incoming fog. You have your landmark in sight, three or four miles off, but suddenly the fog is upon you, like oatmeal. It's so thick you can't even make out your wake. And you have no compass. With no visibility, there's always the danger of going around in circles—even heading back out to sea. But it is still possible to steer a straight course. All you need is a fishing pole (or oar) and a weighted line.

"Prop up the pole or oar in the bow. Then pass the line over the center of the



boat and let it trail astern. Put a weight on it as a drag, say a heavy fish lure.

"Now you're all set. As long as the line is directly astern, you are maintaining a straight course. If you start veering to starboard, the line will start drifting off to the starboard quarter of your boat. If you veer to port, the line will, too.

"But you have to be quick. Get that line out before you lose your heading."

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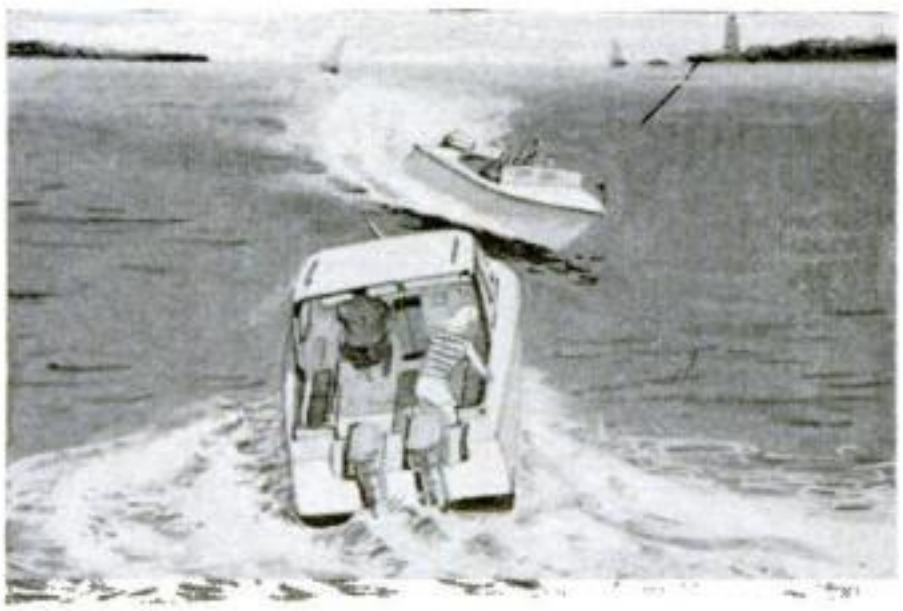
4 "You're within sight of shore and the fish are biting, but fog starts to roll in and again there's no compass aboard.

"Do you have to head for home? Not if you're in shallow water and—again—have a rather long pole aboard. Before the fog closes in, stick the pole firmly into

the mud or sand with a mark (a nail, a patch of paint, or even a prominent knot in the wood) pointing toward your harbor or dock.

"Keep right on fishing and when you want to call it a day, head for home in the direction indicated by the mark on the pole, using the method described in case 3 to keep on a straight course.

"If you were 10 minutes away from shore, run for 10 minutes in the fog, then cut your engines. You'll be close enough to where you want to go to feel your way home."



5 "A boat is bearing down on you on a broadside collision course.

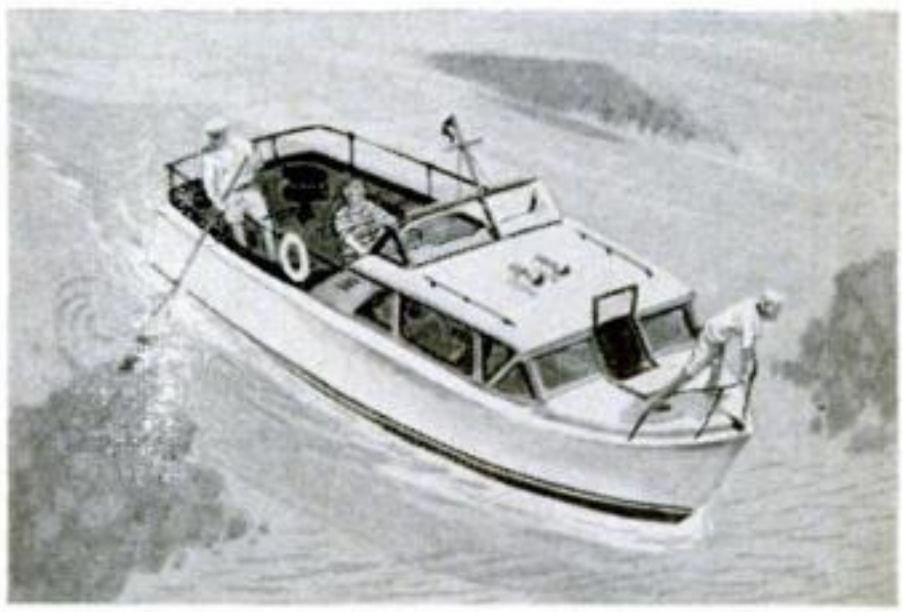
"This is a bad one. No matter what you do, it could be wrong. However, statistics show that the safest maneuver is to turn *towards* the approaching vessel. This will present the smallest possible target and you'll be following one of the rules of good seamanship by attempting to pass 'under his stern.' Unfortunately, this maneuver also poses the danger of a head-on collision at high speed.

"The next best thing is to turn in the same direction in which he's going. Once again, you present a smaller target—this time your stern. And should a collision occur, your speed will cancel out part of his speed.

"It requires quick judgment. But in no case should you try to cross his bow. That's like trying to beat a railroad train to a crossing."

6 "You're underway in strange waters and your hull touches bottom, then pulls clear. Twenty seconds later you touch again. You spot a submerged rock off your port bow. *Thump*—another rock right under you. You've got yourself into shoal water—and your problem now is how to get out.

"First and most important, stop your engine to reduce chances of damaging your prop or puncturing your hull. If you can see your way to deep water (in any situation like this, keep a sharp lookout



for blue water), *push* your boat there with an oar or boat pole. Don't try to get there under power. If you can't see your way clear, don't panic. Unless the seas are very rough, it's better to go aground and wait for high tide before working your way free than to try to get out immediately at any cost—too often that of your boat.

"A straight grounding in calm water, even on rocks, is not as dangerous as you might think. Patience and caution are the key words. You may feel sheepish

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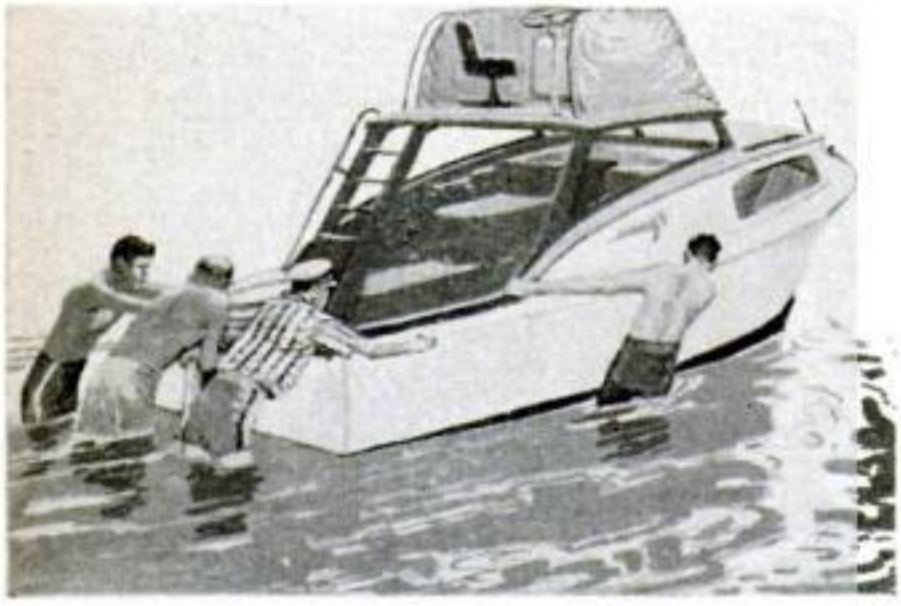
when the boys back at the yacht club ask where you were for seven hours, but your hull will be intact."

7 "You and a party of four or five friends have been out for a day of fishing and swimming. The tide's going out and you're coming in—and suddenly there you are, hard aground on a sand bar. Even experienced boatmen often apply power in such a way as to pull more sand underneath the boat. We don't recommend trying to work your way over the bar. Nor do we recommend trying to back off. And we certainly don't recommend that you just sit there waving your hands in distress, waiting for help.

"The simplest solution, but one which many people forget, or never think



about, is to have your party jump overboard. This lightens the boat immediately and then all hands can push her free."

8 "You're underway. You've hit a submerged object or a seam has opened up. Water is rising rapidly in the boat.

"If your pump can handle it, fine. Head for the nearest port under moderate speed. If it can't, what you do depends on the leak's location and size.

"Let's say you have a small hole up forward at the waterline. Get that hole above water by increasing your speed. This will push your stern down and raise

your bow high enough—hopefully—to stop the leaking.

"But an exactly opposite course of action could be indicated. The most common leak on boats with inboard engines is one caused by a loose fitting on the seawater-intake system. In this case you must *stop* your engines. By doing that, you'll also stop sucking water into the system and into your boat. Then you can either make a repair or radio for a tow.

"If one of your seams opens up, pound rags of clothing into the crack. If a floating log punches a hole in your hull, jam a pillow or cushion over the hole. Makeshift patch-up jobs? Sure. But it's the seaman with his wits about him who comes through in tight spots." ■■

Short takes on what to do . . .

If you lose rudder control: On a twin-screw craft, steer by adjusting the revolutions on each propeller. On a single-screw boat, use an oar or board as a rudder, holding it alongside the hull at the quarter you need leverage.

If you have a fire and no extinguisher: This always poses the danger of explosion. So don your life jackets and get away from your burning boat fast. And hope there are other vessels in the area to pick you up.

If you have to take a boat through surf: If at all possible, don't. But if you must, watch the action of the swells, go in during a lull, and then use enough power to stay ahead of the breaking sea. You'll hit the beach hard, but better that than capsizing at the surf line.

If you're taking water over the transom and an extra-large wake races towards you as a big cruiser crosses your stern: If you turn to take the wake broadside, you could capsize. If you stop, the sea will overtake your boat; you could be swamped. If you speed up, you'll dig your stern deeper into the water. How can you make the best of a bad situation? Maintain speed and maneuver so as to take the predominant swell directly on the stern of your boat.

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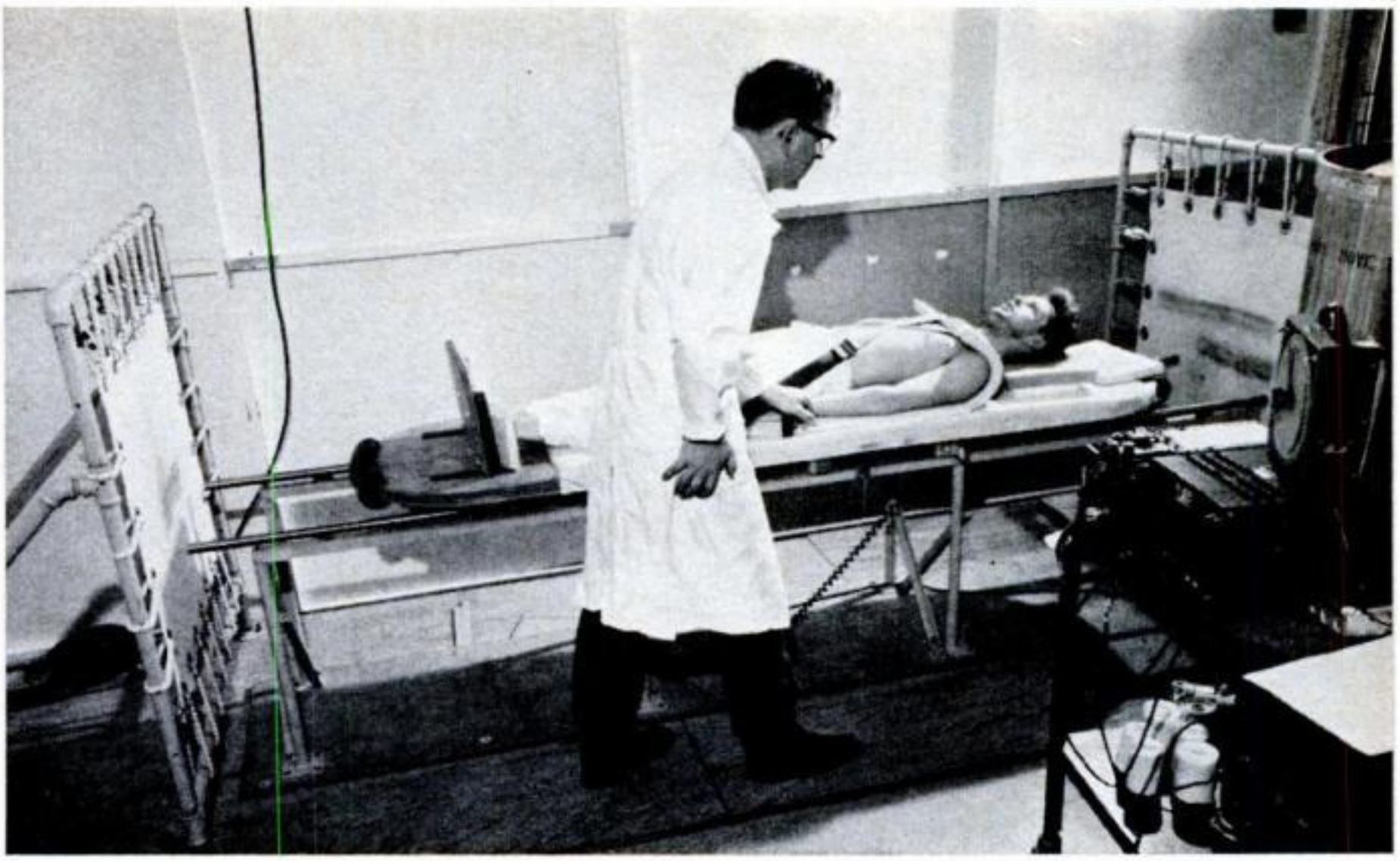
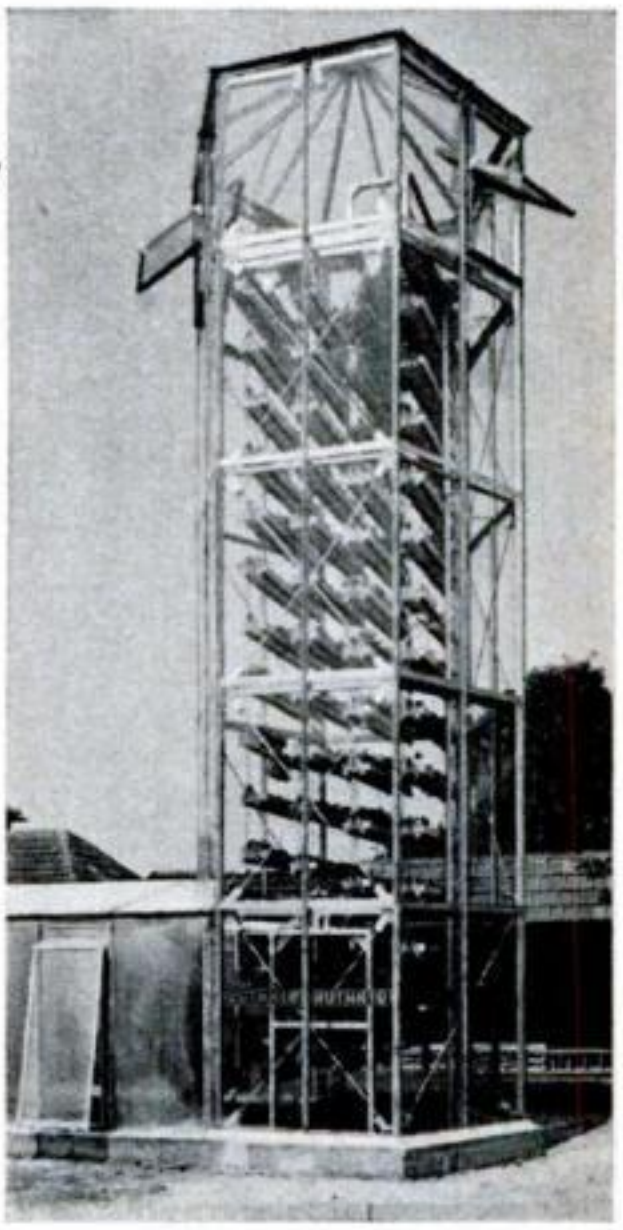


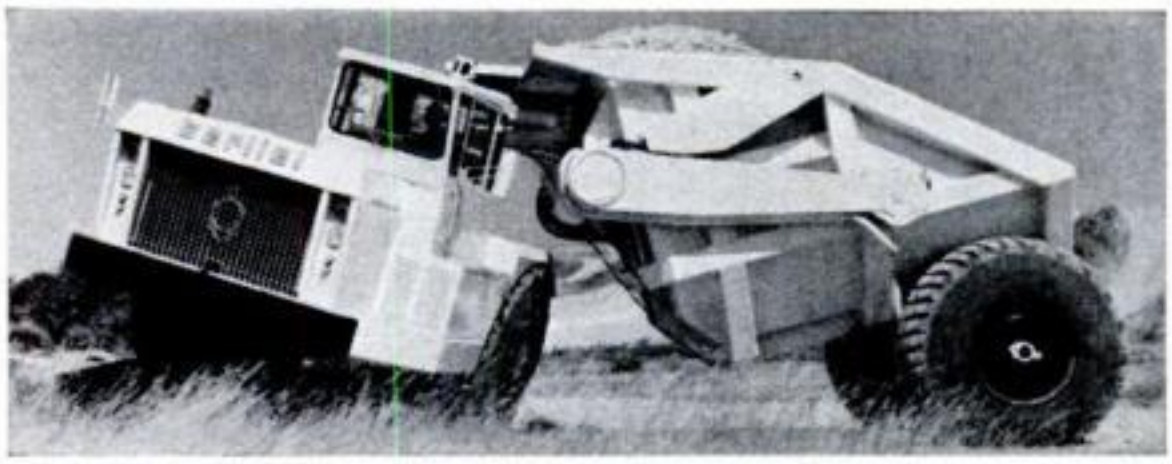
Horizontal Yo-Yo bounces "spaceman" from head to foot

Bouncing while lying down is the latest gimmick in offsetting the effects of prolonged weightlessness in space. To test the idea, Boeing scientists built this bed, which provides temporary simulated gravity of 1½ Gs. It has a trampoline at each end, moves back and forth by motor at intervals after periods of rest to simulate weightlessness. Volunteers for 15-day test periods were monitored for heart action and blood pressure. No complaints have been heard yet on head and foot calluses.

Vertical greenhouse puts sun on every plant

The glass tower at right cultivates potted seedlings with minimum use of land. The Austrian structure houses conveyors that expose plants to alternate sun and shade, making a complete circuit in 25 minutes and dipping the pots in water at the end of each run. It occupies 60 square feet, has a growing area 10 times that size.





Articulated dumper has four-wheel drive

All wheels on the jointed dump truck above are driven by independent electric motors for traction on soft ground. Power for the 40-ton French Berliot is from a 240-hp. diesel-run generator. Regulated by electronic switching, rear wheels progressively disengage as speed rises. Front drive on hard roads is up to 35 m.p.h.

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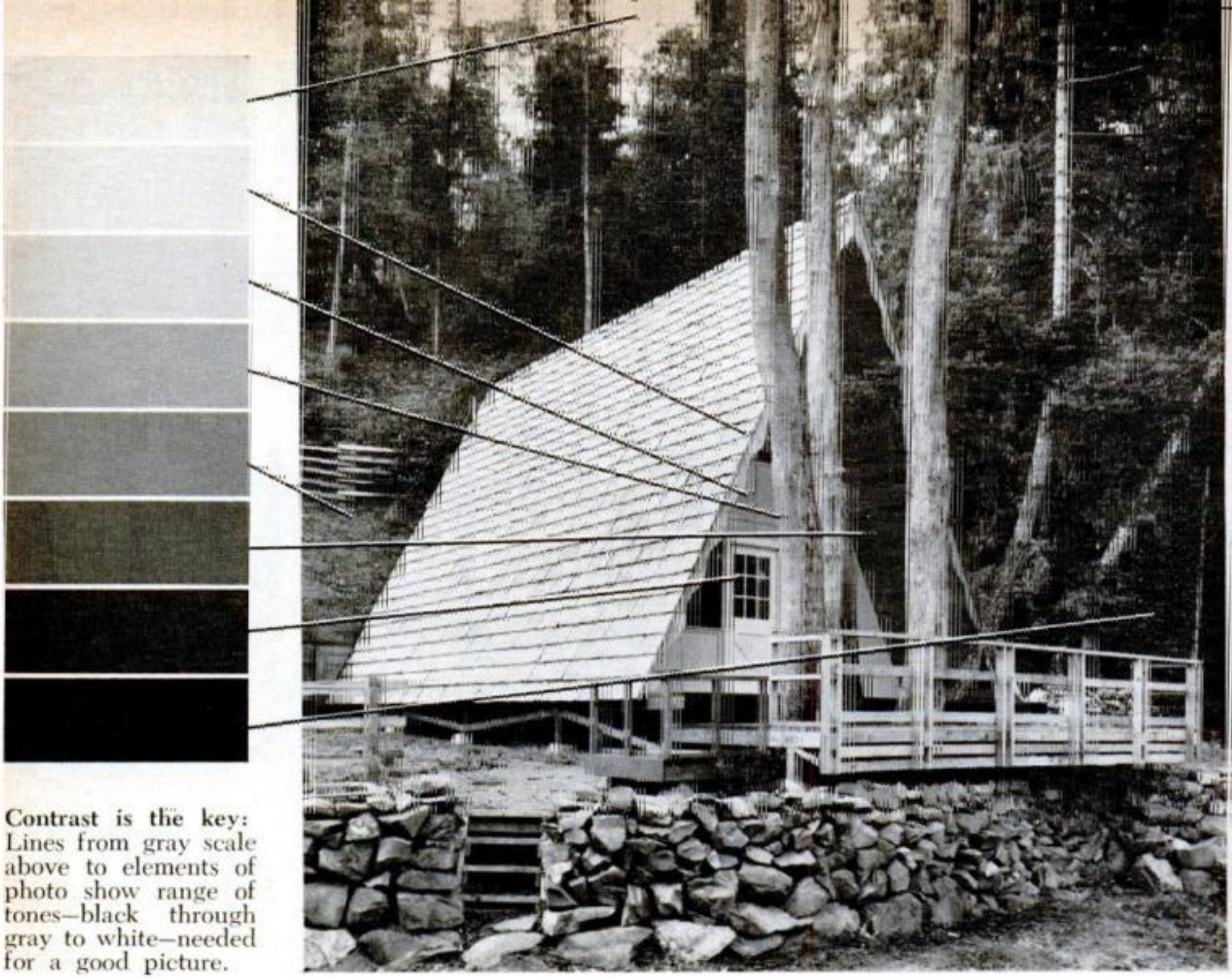

Contrast is the key: Lines from gray scale above to elements of photo show range of tones—black through gray to white—needed for a good picture.

For zing in your photos— CONTROL

By John Burroughs

WHAT is it that separates the amateur photographer from the pro? Most pros, if they had to name one key skill that all pros but few amateurs have, would probably say: the ability to judge and control contrast. A pro thinks in terms of contrast whenever, wherever, and whatever he's shooting. Amateurs usually don't.

Photographic contrast is simply the rate of change in tonal gradation. Every single step you take in producing a black-and-white print (we'll get to color in a while) involves a scale of tones shading from black through gray to white. Actually, of course, you work with three scales: the scene you're photographing (with its scale of tones that you're trying to capture); the film, which reproduces the scene's gray scale on the negative; and the print, which in turn reproduces the negative's scale.

How do you go about getting that scale of tones you see in your subject on a print? Let's consider the problem of subject contrast first.

Subject contrast (also called brightness range) is best expressed as a ratio. If you were to take a spot exposure meter and measure separately the light reaching your camera from both the brightest and the least-brilliant portions of a subject in full summer sunshine, you'd find the ratio between these luminosities very high. It might reach 1,000:1—that is, the highlights

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PS PHOTOGRAPHY

Lessening contrast was the problem the photographer faced here. Taken in bright sunlight, picture would have been too contrasty — shadows, washed-out face — if photographer had not compressed the negative scale with 10-percent underdevelopment. Photo of house (far left) offered opposite challenge. Taken on gray day, it would have had too little contrast if negative was developed normally. With 25-percent overdevelopment, gray scale of negative was expanded to yield a normal print on No. 2 paper.

the CONTRAST

would be reflecting 1,000 times as much light as the deepest shadows.

Photographic materials haven't sufficient latitude to record this broad range of tonality exactly as your eye sees it. Your eye can adapt to widely varying scales of illumination, can perceive detail within the deep shadows and the brilliant highlights of a scene simultaneously. But when film records a subject with an extreme brightness range (presuming exposure was based on the subject's midtones), it "sees" shadows as opaque black, highlights as blank white. That's why snapshots taken in bright sunlight have a soot-and-whitewash look.

What happens if you measure that same subject when the sun is slightly hazy? You'd find the brightness range somewhere between 250:1 and 50:1—within the film's latitude. Photos of subjects with this "normal" ratio show detail in all but the very deepest shadows and in all but the very brightest highlights—approximately as the human eye sees any scene. Even the rankest amateur's snapshots of a hazy-sunlit subject therefore turn out beautifully.

On a cloudy, completely overcast day, measurement would show that same subject's brightness range to be very low, perhaps (with a subject all the same color) as low as 3:1. Under these conditions shadows are so "soft" they're barely perceptible. A snapshot would turn out flat and muddy looking even when printed on high-contrast paper.

A pro cameraman shooting a subject with

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Why keep your subject in the dark when it's so easy to use

Shadowed elk (above) resulted from excessive brightness range: burning sun, deep shadow. Fill-in flash compressed this range (photo at right) by lighting up shadowed portions of subject and thus decreasing the ratio of contrast between light and dark. Other possible solutions: underdevelop negative or print on less-contrasty paper.

an unusually high or low brightness range does his best to "normalize" the scene's ratio in some way, often with flash.

In the case of a high-ratio subject close to the camera, relatively weak on-camera flash will "fill" shadows enough to compress the brightness range to normal. For example, if the flash adds five units of light to both highlights and shadows of a scene with a 1,000:1 scale, the ratio becomes 1,005:6, or 167:1. In the case of a subject with a very low ratio, flash can be used off-camera to provide natural-looking highlights that expand the range of brightness to normal.

Or a reflector can be used, instead of flash, to fill shadows and lower a high ratio. Screening the subject with cheesecloth to soften harsh, sunlit highlights is also effective. In the early days of Hollywood, many movies were shot in old greenhouses—moviemakers discovered that the dusty glass panes filtered glaring sunlight just the right amount to give a scene optimum contrast.

Indoors, the ratio of a subject can be lowered with flash or flood bounced off a nearby wall.

With an indoor subject lighted entirely with floods, use at least two lights, one a high-key light and the other a fill light at the camera. Moving the fill light in or out to illuminate the subject with ⅓ to ½ the intensity of the key light will give normal contrast.

It isn't possible to control the brightness range of all subjects, of course. A subject at a distance from the camera, for example, must be shot as is.

Negative contrast, which the pro terms gamma, can be increased with extended development, decreased with curtailed development. Because developers work more actively on exposed portions of the film, highlights in the negative (the blacker portions) build density during development faster than shadows.

A negative of a subject with a normal brightness range should always receive normal development, according to the manufacturer's instructions. Even when the brightness range of a subject is moderately high or low, a normally developed negative can be printed satisfactorily on low- or high-contrast paper.

When the scale of the scene photographed is extremely high or low, however, most pros compensate—particularly when the brightness range is low—by adjusting the time of negative development. The decision as to what development to give is a matter of judgment. Do you prefer *literal* reproduction of the subject (normal development to give a low-contrast photo of a low-ratio scene, for example) or *pleasing* reproduction (overdevelopment to give a

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fill-in light? Even a simple newspaper reflector helps

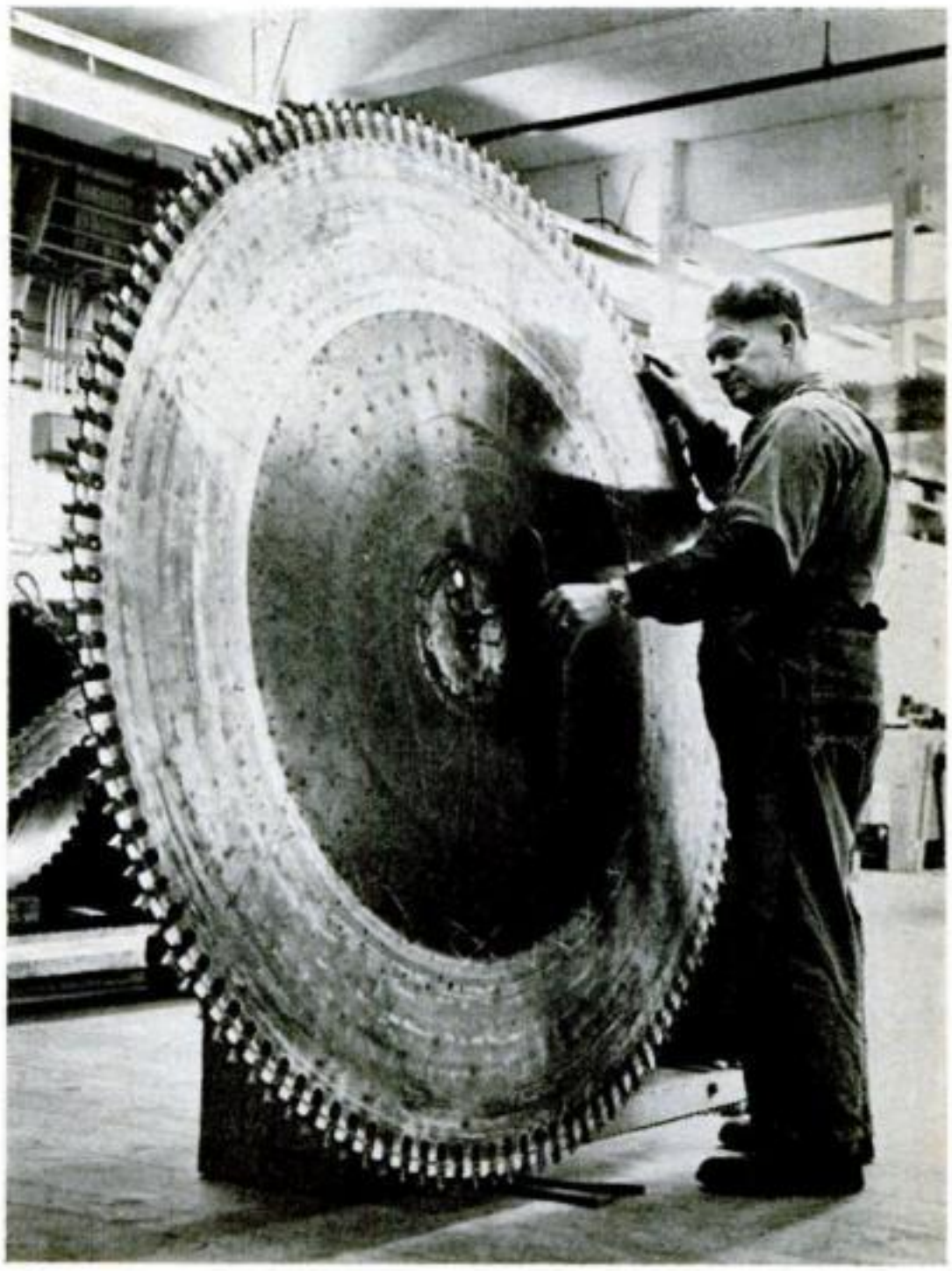
Shadowed boy (above) also shows excessive brightness range: sun pouring in through window, face in dark shadow. Photographer solved problem by using a projector screen to reflect light back onto boy's face (left). White cardboard or even newspaper would have done, too. Reflected light is softer, more diffuse, than flash.

normal-contrast photo of that low-ratio scene)?

The degree of over- or under-development advisable depends in part upon the inherent contrast of your film as well as upon the subject contrast. Premium-quality fine-grained films, which have higher contrast and less latitude than all-purpose pan films, should seldom be over- or under-developed by more than 10 percent. Fast pan films can be developed an extra 25 percent without appreciable quality loss. With most film-developer combinations, 25-percent overdevelopment increases negative contrast the equivalent of two paper grades.

Some allowance in exposure is necessary when film is to be given other than normal development. A half stop less will be needed when development will be extended; a half stop more is required when development will be shortened.

In nearly all his shooting, the pro exposes for the darker half of his subject's gray scale, in order to record important shadow detail on the negative. He then develops his film to proper contrast



Shooting indoors by available light makes for natural pictures, without artificial shadows that flash creates. Frequent disadvantage: low contrast. For this shot of a lumber-mill saw filer gauging tension of a circular saw, negative was overdeveloped to spark contrast.

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Urheberrechtlich geschütztes Material

Burning out the background is a favorite trick of pro photographers. Secret: Set exposure for dark subject in foreground, overdevelop negative. Background, blocked out, prints white.

to print properly on No. 2 enlarging paper.

What is "important shadow detail"? Suppose you're shooting an outdoor portrait. While facial highlights are important in a portrait, sharp, well-defined detail in the eyes and hair, which are darker in tone than skin, is also important. Accordingly, taking a meter reading from the skin tone and increasing the indicated exposure one stop to register detail in eyes and hair will give a properly exposed negative.

There are several reasons for developing all negatives to sufficient contrast to print well on No. 2 paper. One, you then ordinarily use only one or two grades of paper. Another, you save considerable time in printing, since it's much easier to make good prints from normal-contrast negatives than from high- or low-contrast negatives. Still another, you allow yourself the widest possible margin for error.

Correct print contrast is a matter of selecting a grade of printing paper that matches the scale of the negative.

If you're in doubt about which contrast grade of paper to choose, don't hesitate to take the shrewd-guess, trial-and-error approach. Unless you're after some special effect, a quality print should show a full tone scale—the very deepest shadows true black, the very hottest highlights pure white, with a range of well-separated tones between. On critical jobs, a pro photographer often makes a number of prints, then selects the best.

Giving the paper minimum exposure and full two-minute development brings out all the "snap" inherent in the emulsion. Some dodging or burning-in—in effect, local control of contrast—is usually needed when printing even the best of negatives.

When judging wet prints in the darkroom, remember that a dry print has less contrast and appears slightly darker than in the developing tray or wash water.

Prints for photomechanical reproduction are generally printed with lighter shadow tones and stronger highlight detail than prints for exhibition. Portraits that will be hung on walls and viewed in dim light should also be printed light in tone.

Color film, which is inherently high-contrast, narrow-latitude material, calls for less subject contrast than black-and-white film (except for distant subjects and landscapes, where high contrast appears normal). For natural color shading, the brightness range of a subject close to the camera should seldom exceed 25:1. Since it's not possible for most of us to compensate for insufficient or excessive subject contrast when color film is processed, controlling the subject's ratio with supplementary fill light is most important.

Keep that high contrast in mind, too, when you make black-and-white negatives from your color slides. Compensate by shortening the developing time of your black-and-white film.

Exposure is very critical with color. When shooting color negatives, a pro exposes for tones slightly below the middle of the subject's gray scale—the important shadows. When shooting reversal material (transparencies), he exposes for tones slightly above the middle—such as the darker skin tones.

Considering your photographic subjects and materials in these terms—terms of contrast—you'll soon find yourself technically proficient at any kind of photography. For controlling contrast is the real secret of professional-level work. ■■

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Compact Minoltina P has wide-angle lens

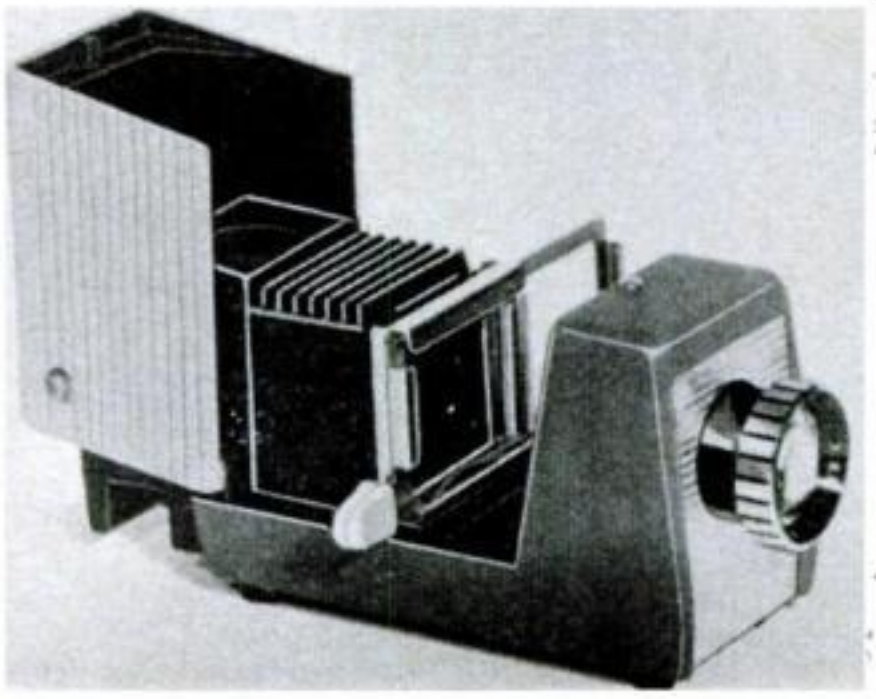
Slim and light, this new Minoltina P looks almost like a half-frame camera, yet takes standard 35mm pictures. The built-in selenium light meter is coupled to the diaphragm ring for simple exposure control. The lens is a wide-angle 38mm *f*/2.8. Film is advanced by a single-stroke lever. $60. Minolta Corp.

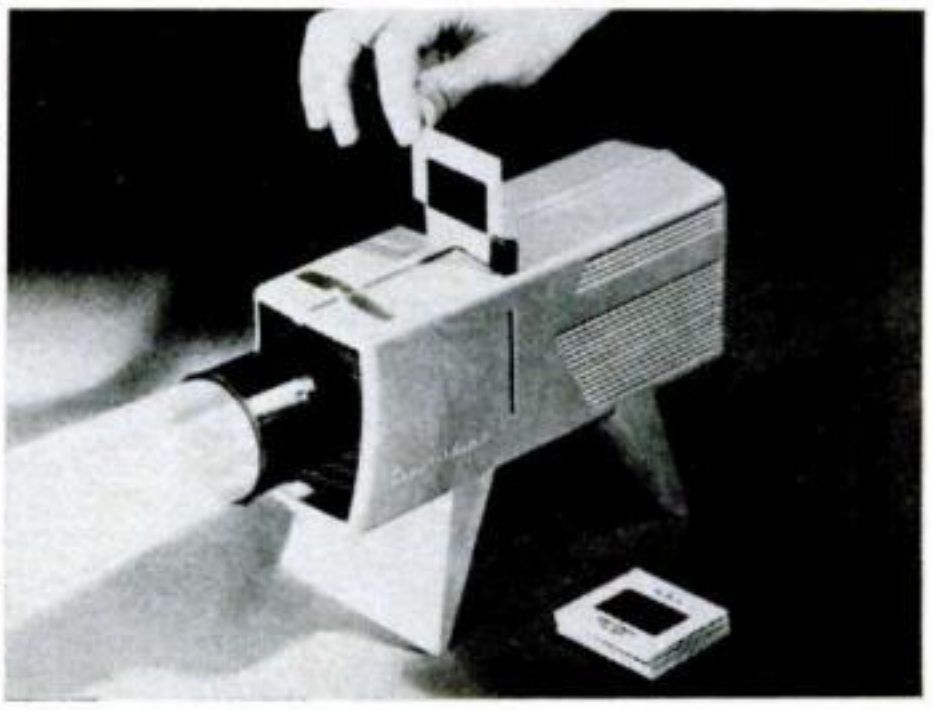
Behind-lens meter, through-lens view

Putting the meter behind the lens gives the Bauer Electric S 8mm movie camera more accurate exposure, while through-the-lens viewing lets you compose and frame the picture accurately. The lens zooms from 7.5mm to 30mm. $180. Allied Impex Corp., NYC 10.

Camera support rides on your belt

With its lower end snugged over your belt and a neck strap to secure its upper end, the Belt-Pod steadies your camera for slow exposures or leaves you free to walk around with the camera in shooting position. Price: $6. Testrite Instrument Co., Newark 5, N.J.

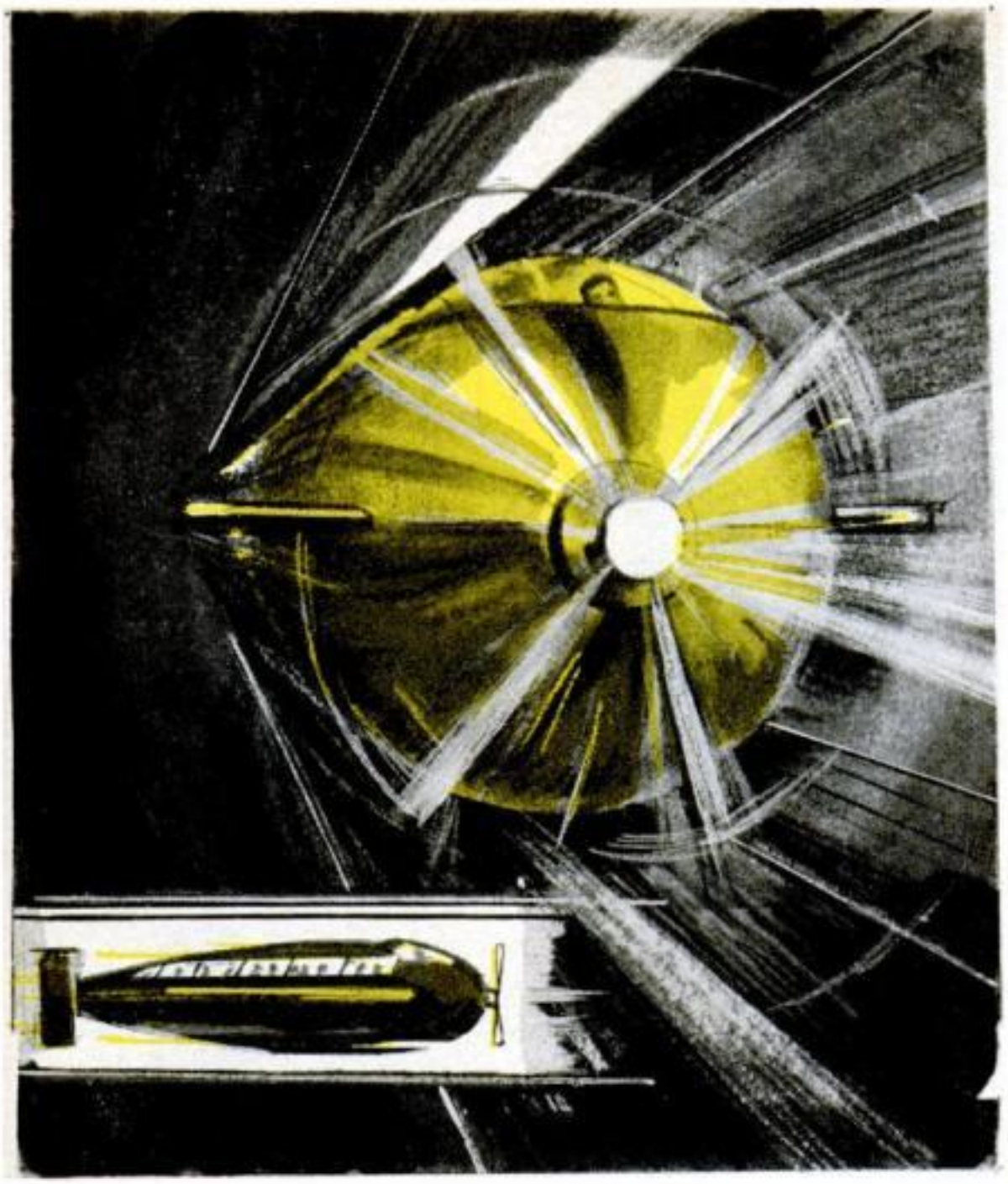




Tiny projectors: one AC, one battery

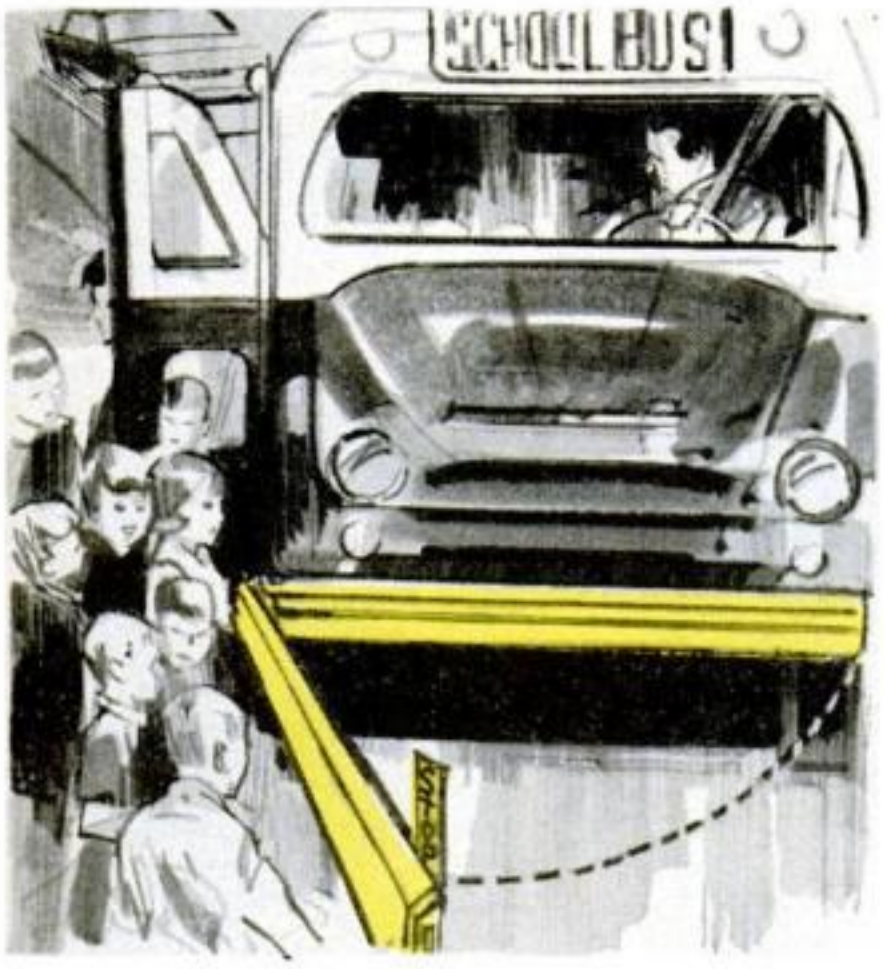
These tiny projectors, scarcely more than palm size, let you carry your slide show along with a minimum of gear. The Accura (left) weighs 26 ounces, is made of metal, has a three-inch lens and 100-watt lamp, plugs into AC. A slide carrier eases operation. Price $19.95 from Spiratone, Inc., 135-06 Northern Blvd., Flushing, N. Y. The plastic projector above works off three flashlight batteries, projects a 12-by-18-inch picture. It costs $7.95 from Value Village, Box 501-CP, Buffalo, N. Y.

Urheberrechtlich geschütztes Material

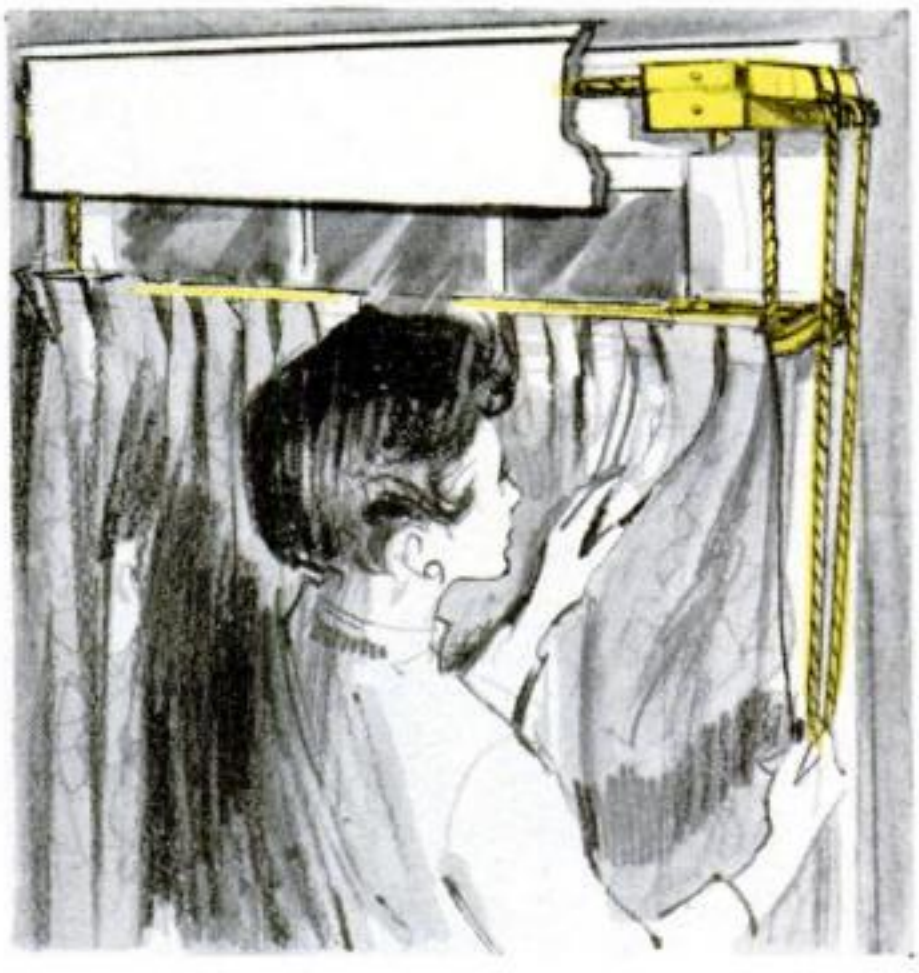


New Ideas from the Inventors

Subway train rides on air. Compressed air could support and cushion trains like this during passage through underground—or underwater—tunnels, says a recent patent. Instruments in cars would adjust air pressure to keep a train centered in the tunnel or lower it for station stops. Jet engines would propel the cigar-shaped single- or multi-car trains.



Bus bumper keeps kids in line. This safety gate would swing out from the bumper of a school bus to hold children at the curb until it was safe for them to cross. It would be controlled by the driver, who would swing out the gate to bar the crosswalk before opening the door. Closed, it would fit into a recess in the main bumper.



Rod lowers to take on curtain. A woman wouldn't have to climb a chair or ladder to hang or remove curtains on a tracked rod like this one. It would ride down from its window-top bracket, even with cornices or valances in place. Notched hooks on the brackets would lock into slots in the movable part of the rod structure.

Urheberrechtlich geschütztes Material

Car weight drives tent pegs. Clamped to a bumper of a jeep or other vehicle. this peg driver would sink arrowhead tent anchors into cold, hard ground faster and easier than the conventional sledge hammer. Turning a ratcheted screw would drive a nonrotating rod collared to the anchor. Reversing the screw would retrieve the rod.

Toenailer sets floorboards. Notched to grip the tongue of tongue-and-groove lumber, this flooring aid should guide and hold boards even close up against a wall. It would feed nails into an angled slot so you could drive them by hammering a plunger, speeding flooring work and letting you do most of it standing nearly erect.

Boat is its own trailer. There'd be no need for a separate trailer if your boat had socket plates for wheels bolted over holes in the hull. Each plate would receive a tapered plug, the combination forming a lock-in wheel bearing. Mounting or demounting wheels should be easier than getting a boat on and off a trailer.

The following patents have been issued on these inventions: **Air-cushion train**—*No. 3,155,050 to Theodore Hafner, NYC;* **Bumper gate**—*No. 3,153,398 to George Runkle and Gilbert Sheets, Lima, Ohio;* **Curtain rod**—*No. 3,005,557 to G. Lundquist and Carl Hess, Superior, Wis.;* **Peg driver**—*No. 3,127,150 to J. M. Dunston, Natick, Mass.;* **Toenailer**—*No. 3,112,488 to H. W. Dettloff, Q. Wagner, and Jack De Luca, Bellevue, Ohio;* **Wheel plates**—*No. 3,135,560 to G. A. Carlson, Monessen, Pa.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 25 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

Urheberrechtlich geschütztes Material

Three antennas on truck, one revolving on front, pick up signals from TV sets in six-block area.

Cruising television truck spots the channel you are watching

Any day or night Californians may see a truck with antennas on the roof and in the front slowly cruising suburban streets. Without disturbing the residents, it's recording the channels to which the TV sets in the houses are tuned. Each truck in the

Dry-land trainer for neophyte sailors

An hour on the indoor Sail Trainer shown above, says the British inventor, equals a day on the water. Inspired by the Link flight trainer, it's a full-scale racing dinghy trunnion-mounted on a swiveling cradle.

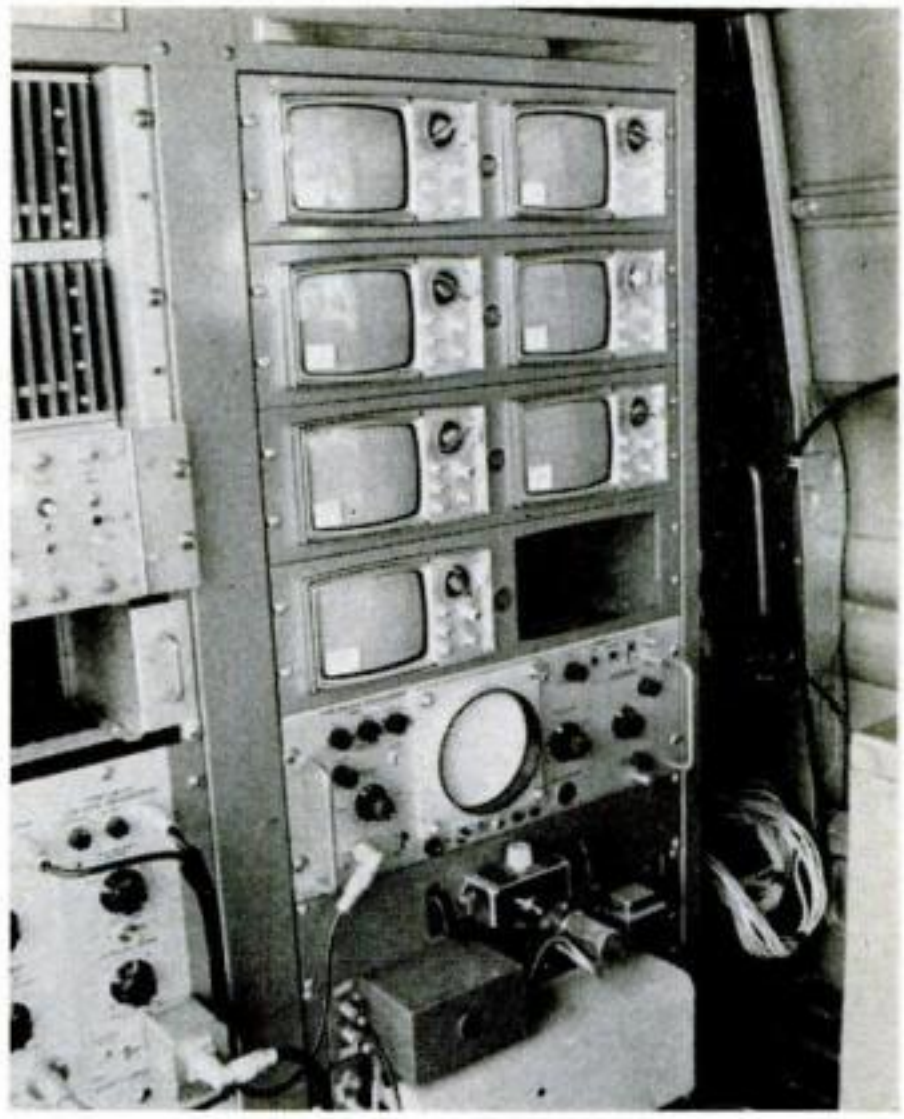
Instructor's panel has controls for direction, speed, tilt, wind, and boom movement. Training sequence is outlined in prepared lesson sheet.

◀ **Students take corrective action** as instructor heels boat to starboard. Fan on power-driven tripod is positioned to show wind direction.

Electric motors heel up to 50 degrees in either direction, swing the boom, vibrate the jib, and power a rubber-tired wheel that rotates the entire setup. An instructor at a console establishes wind problems by controlling hull turning and heeling, boom swings, and jib flutter.

Urheberrechtlich geschütztes Material

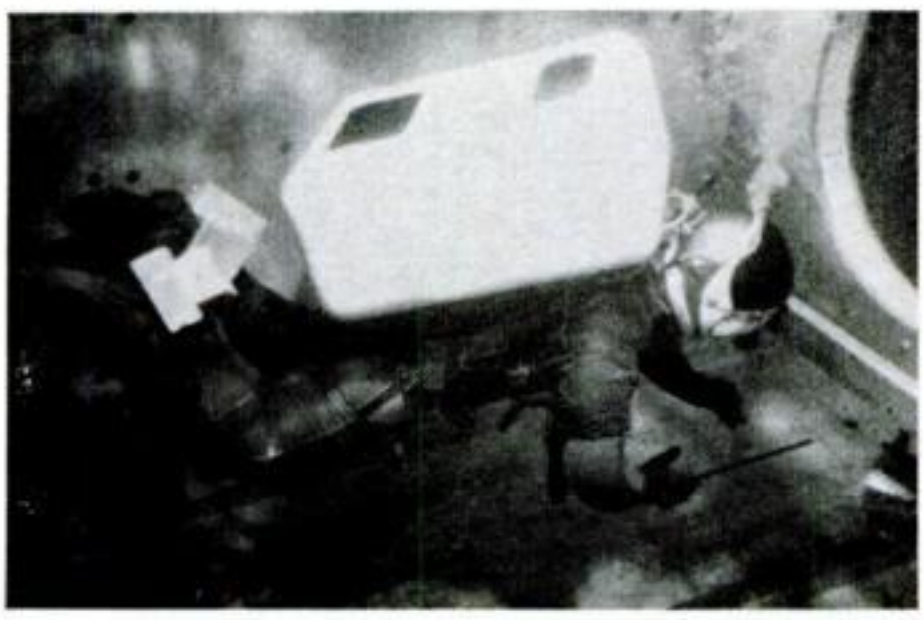
Truck roaming silently in street makes record of TV channels tuned in to all houses on route.



Screens in bank inside truck are connected to a recorder and tuned to channels serving area.

Tanner Electronic Survey Tabulation fleet can record up to 106 sets a minute.

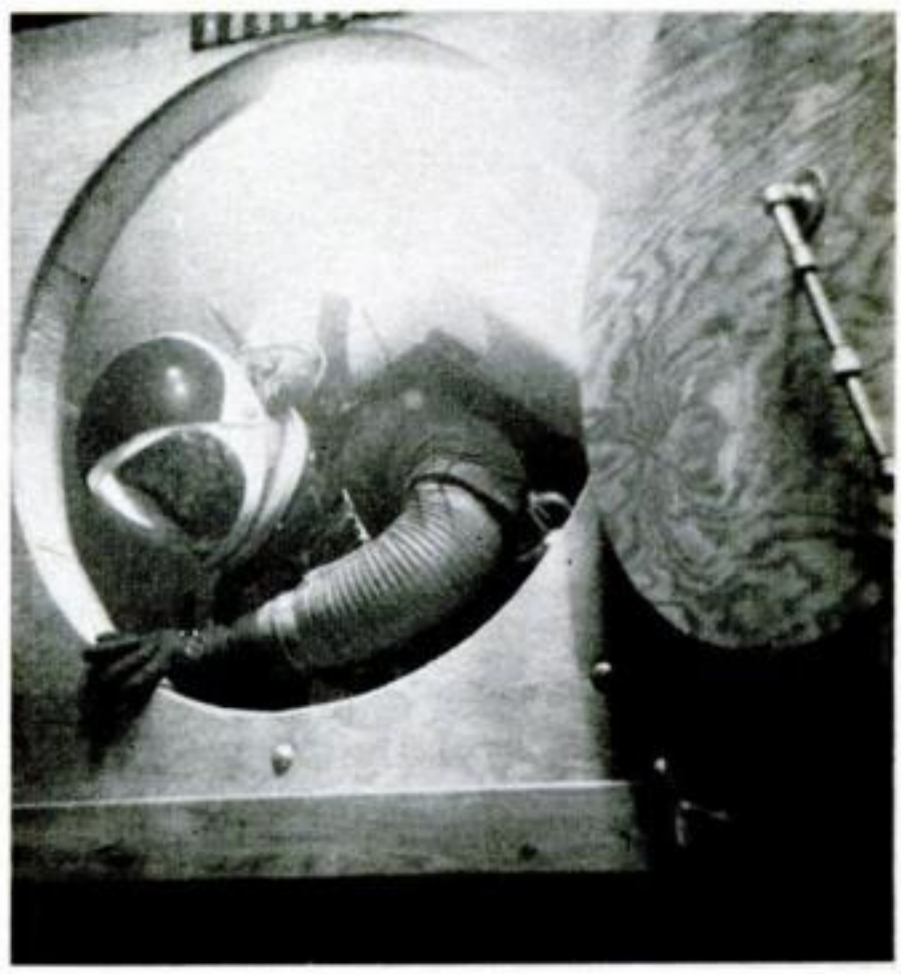
Inside the truck, packed with electronic equipment, are receivers tuned to the channels serving the area. Each unit picks up a signal from the sets in the houses, records it on tape with time, location, and channel. The tape is fed into a computer, and the information passed on to TV-station and advertising subscribers.



Underwater trainer for spacemen

Astronauts now get practice performing space tasks in a water-filled laboratory. Their suits are ballasted with water to create conditions resembling the zero gravity encountered in space. Simple jobs devised by Boeing include turning a screw, pulling a lever, waving an arm, floating through a hatch, or making a right-angle turn—all unfamiliar exercises in the weightless environment of orbital flight.

◀ **Space-suited astronaut,** ankles weighted and breathing pack on back, "floats" under water.

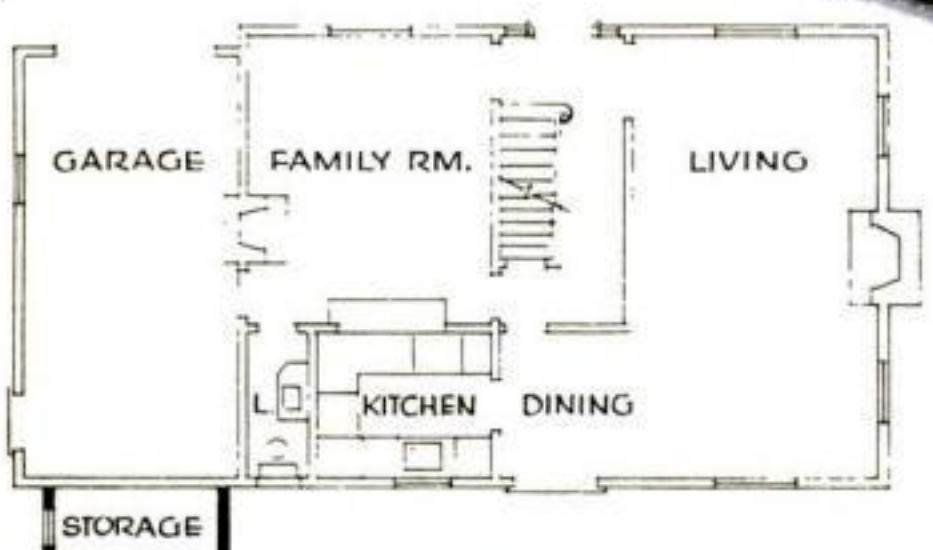


Exercises at near-zero gravity include entering hatch of spacecraft mock-up in water chamber.

Urheberrechtlich geschütztes Material

9 New Plans for

1 Add-On Storage



For a typical development house (see floor plan at lower left), here's a sound idea: At the rear of the garage build a 4'-by-9' storage closet designed to look like a part of the original house. Roof pitch, windows, doors, and exterior finish of this storage unit should be the same as the garage to which it is to be attached. Make the floor of concrete. Pour it over a well-tamped gravel bed. If you want to store large power equipment, such as a riding mower, a concrete ramp should be part of the design. Use ¾" exterior A-C plywood over the usual two-by-four frame. Two-by-four rafters are adequate for the roof. The joints between the garage and this new unit must be waterproofed, and the joint between the new roof and the garage wall flashed. Be sure to anchor the sole plate supporting the studs with ½" bolts embedded in the slab. It's a good idea, too, to bring in electricity from the garage for lighting. And if you have a cold-water line nearby, extend it to a sill faucet in the storage center.

By Carl Sigman

YOU and your architect may spend hours and hours planning for living comfort in a new house, but it's a rare modern home that doesn't suffer from one important deficiency—a lack of space to store the garden equipment and furniture you use outdoors.

Where would *you* keep a suburban tractor if you decided to buy one? Where do you now keep your mower? The supplies you use to maintain your garden? Your outdoor furniture?

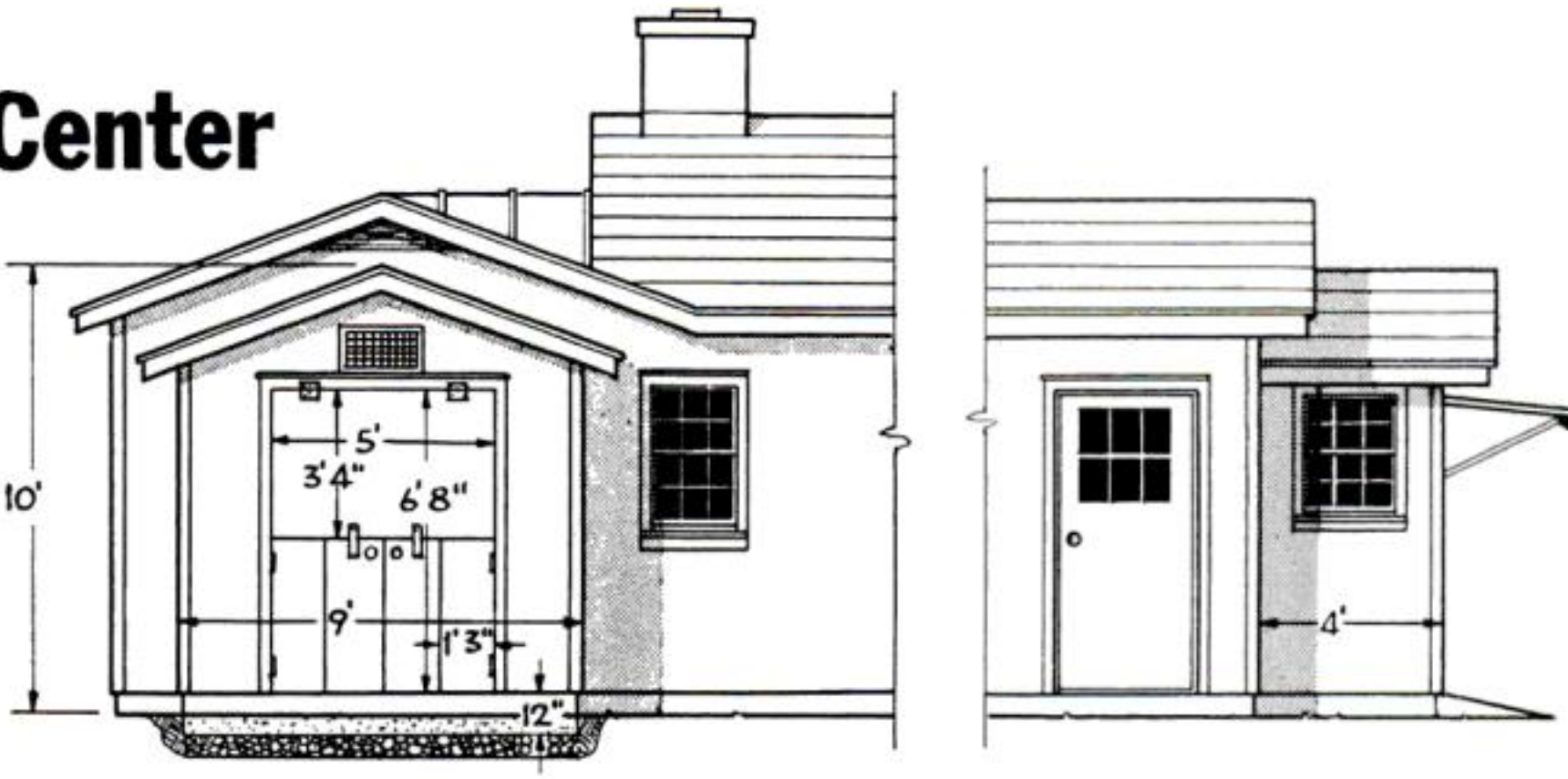
The answer usually is the garage, a structure that is often already overburdened merely to keep a car or pair of cars out of the weather.

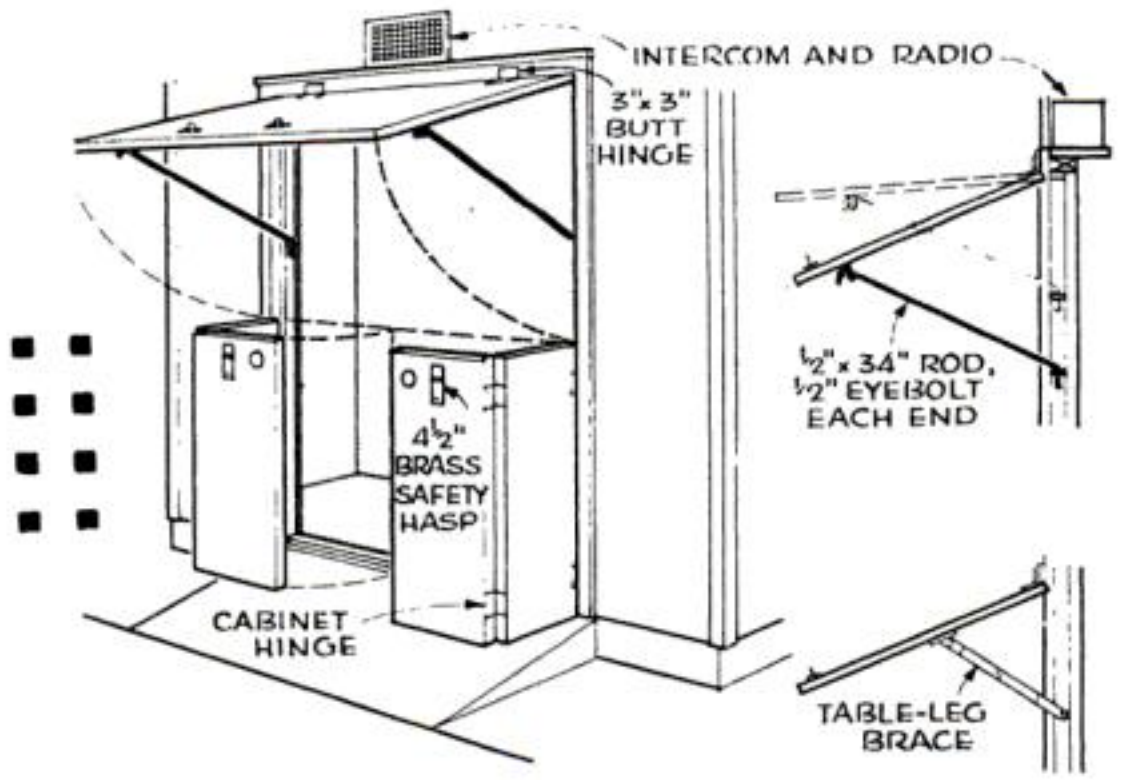
To prevent everything from ending up in a wild jumble, in the garage if nowhere else, it's best to design and build storage spaces for each of the items you own. As a starter, we suggest you take a look at the storage ideas presented here.

Urheberrechtlich geschütztes Material

Outdoor Storage

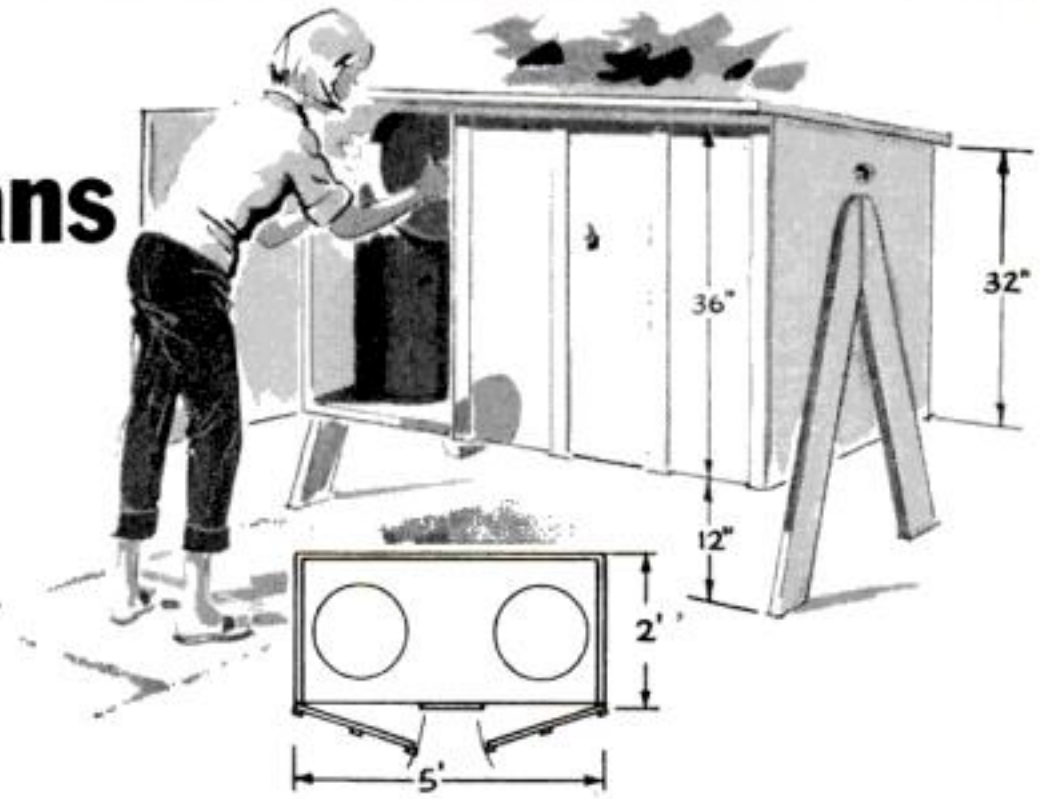
Center





Door for the add-on storage center is made as in drawings at right. Use ¾" exterior plywood. The upper half lifts up to become an awning. Support this with ½" rods and eyebolts screwed into the door jamb and into the awning's underside, or install a pair of table-leg braces. Use safety hasps to lock the top of the door to the folding bottom sections below.

2 Hide Refuse Cans



An elevated enclosure for refuse cans is an easy project. It stands on A frames embedded in concrete. Exterior plywood (¾") is suggested. The roof can be made of plywood or one-by-six roofers, covered with roll roofing. Use a noncorroding metal drip edge. At either end install a 2" round venting louver. Heavy metal angles under the cabinet and fastened to the A frame prevent undue side thrust.

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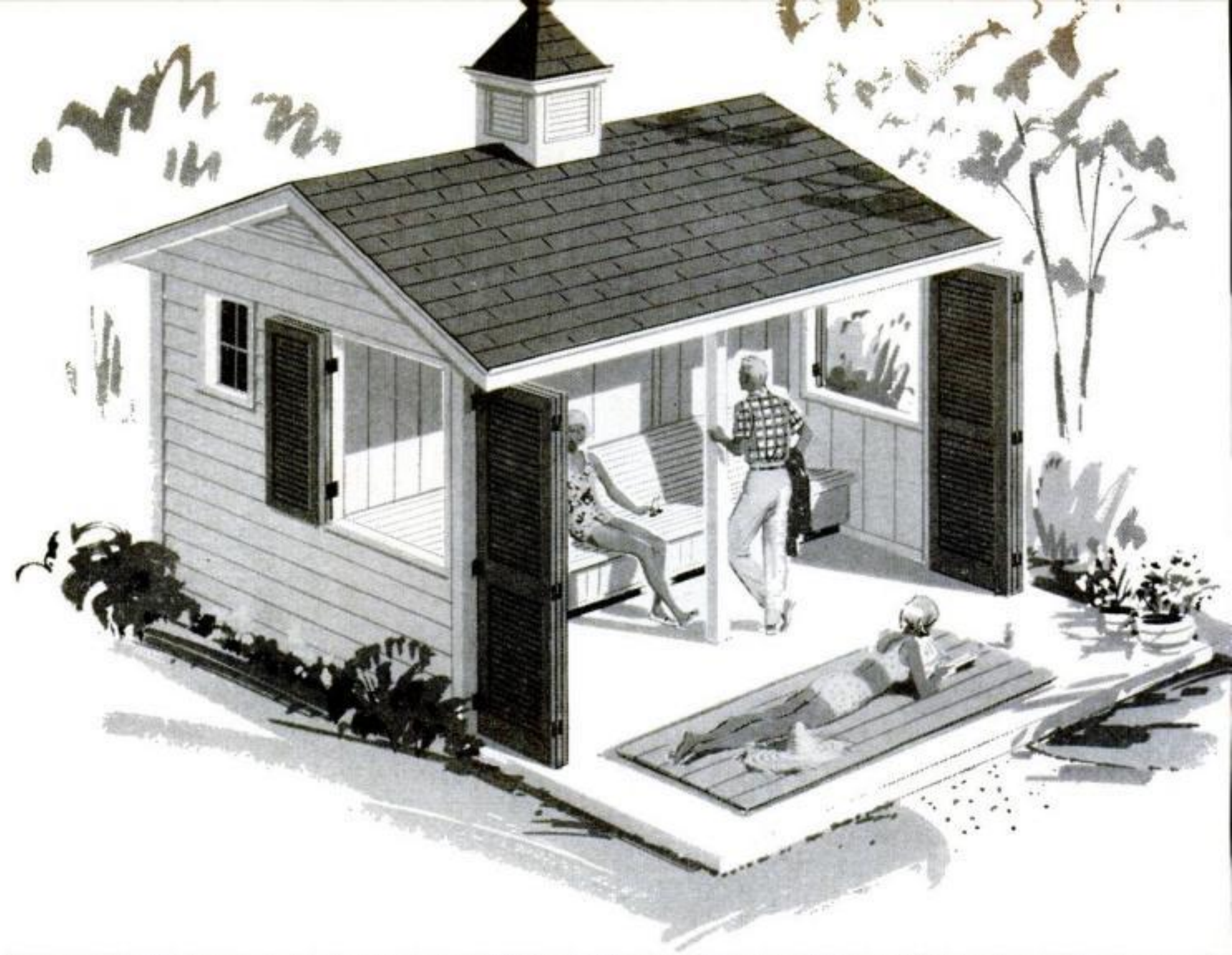
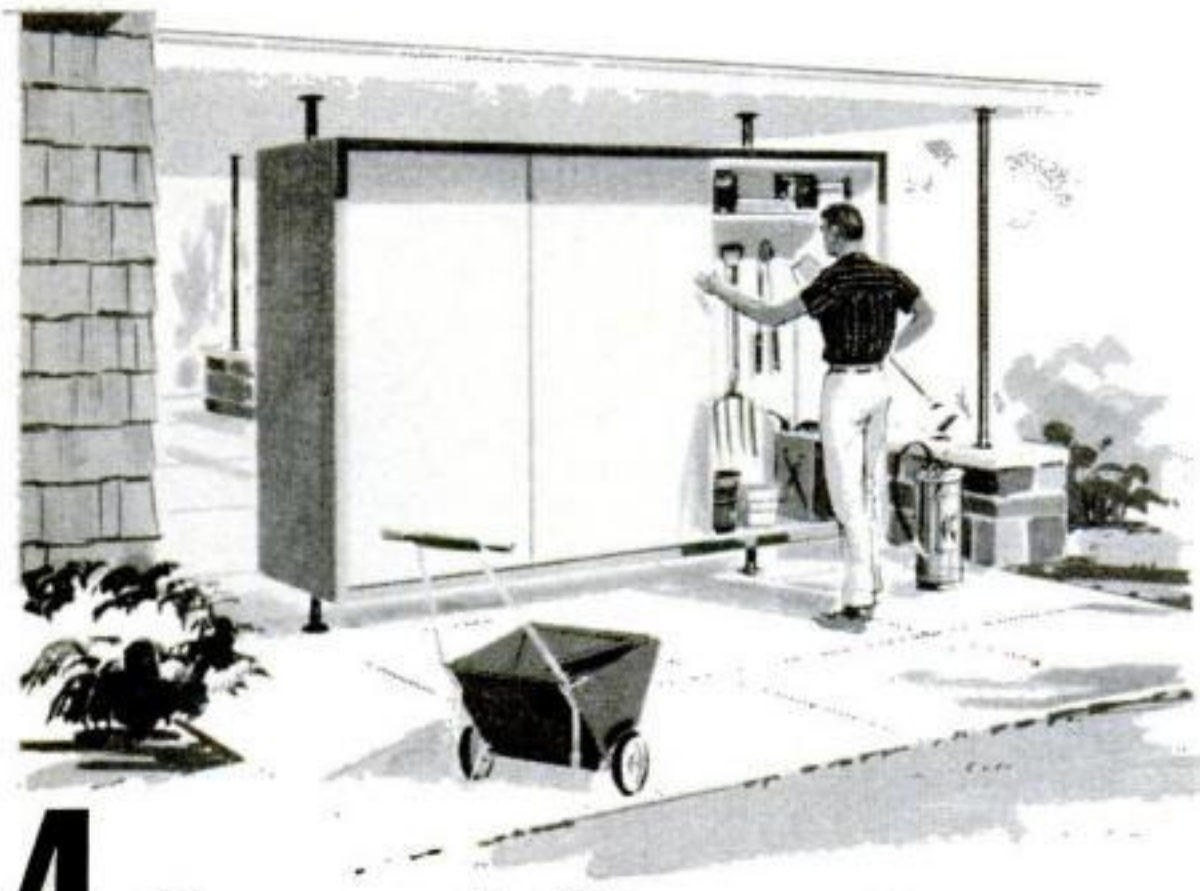
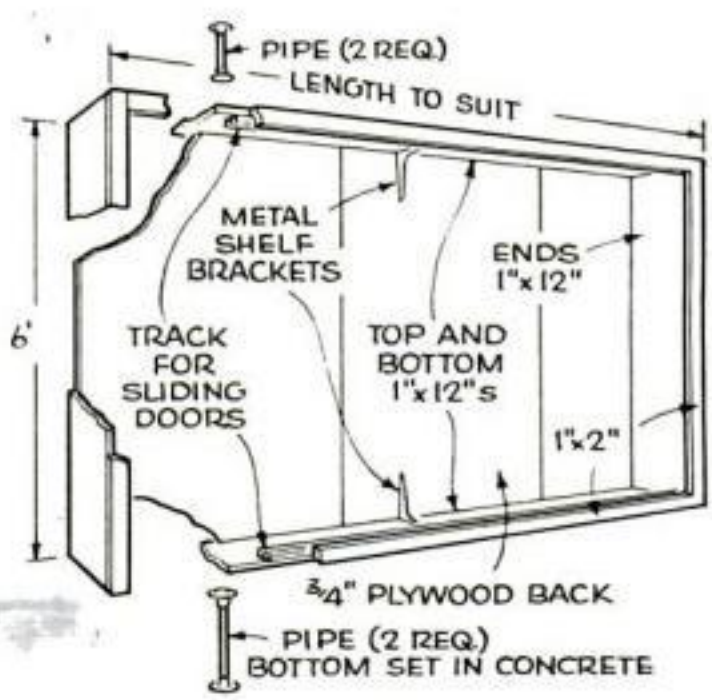
Urheberrechtlich geschütztes Material







4 Carport Storage

At the back end of a carport you can build a cabinet for garden tools or to store auto equipment. It's held in place top and bottom with pipe and floor flanges. Use ¾" outdoor plywood for the sliding doors, and put them on non-corroding metal tracks. Length and depth of the closet can vary, depending upon your storage needs and your carport size. You could double the depth with a central partition of perforated hardboard, placing sliding doors on both sides. A controlling factor of the cabinet length might be door size. These should not exceed 4′ in width. If you stick to this, you'll be able to use a standard plywood panel.

Urheberrechtlich geschütztes Material

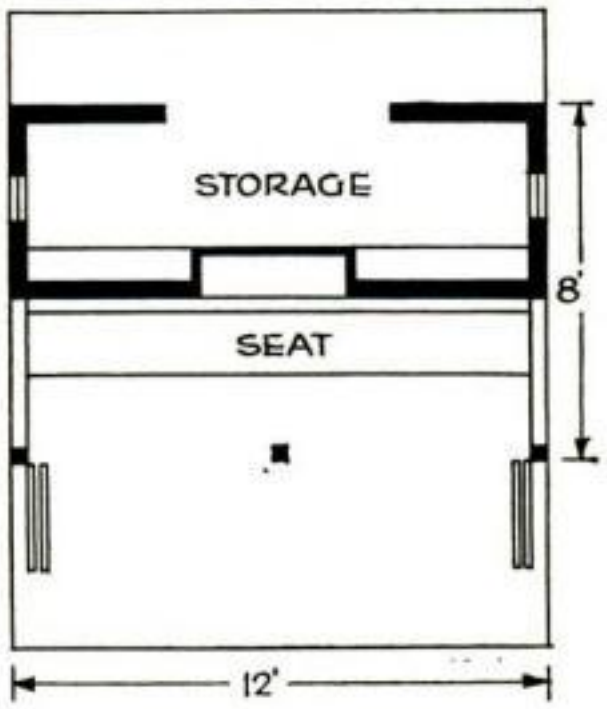
REAR

SIDE

FRONT

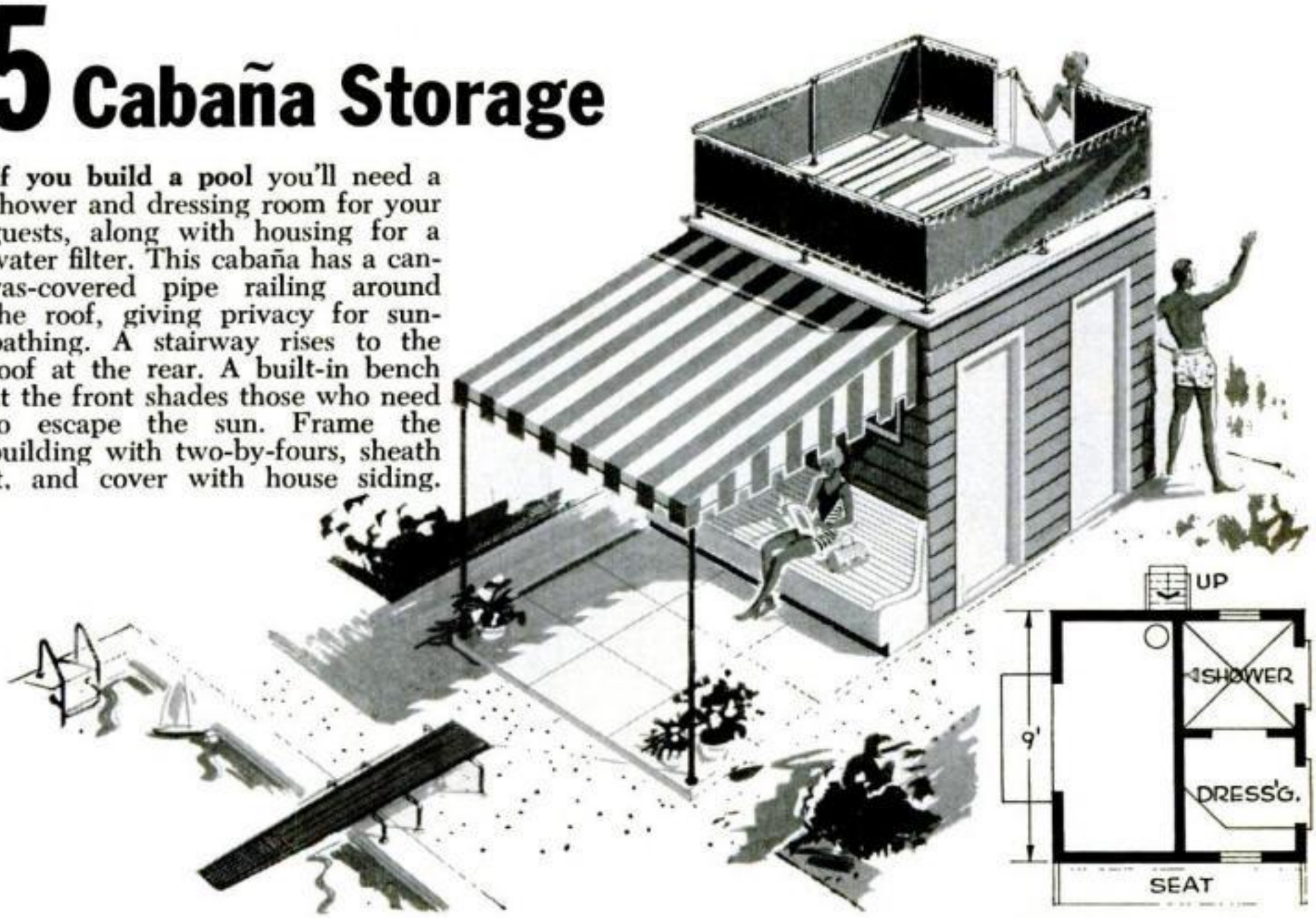
3 A Summer House

Out on your lawn, perhaps as a focal point in the view from your living room, build a summer house where you can sit in the shade or lie in the sun during the warm season. In the winter, close the folding doors and shutters and store bulky outdoor furniture. Drawers under the seat and a cabinet over it take barbecue equipment. At the rear is space for garden tools. Build this house beside a pool and you can use the rear space for a shower and dressing rooms. The cupola gives ventilation and hides a loudspeaker. Build the house on a slab, using a 6" mesh to reinforce the concrete. Inquire about a local building permit before you start to work.



5 Cabaña Storage

If you build a pool you'll need a shower and dressing room for your guests, along with housing for a water filter. This cabaña has a canvas-covered pipe railing around the roof, giving privacy for sunbathing. A stairway rises to the roof at the rear. A built-in bench at the front shades those who need to escape the sun. Frame the building with two-by-fours, sheath it, and cover with house siding.



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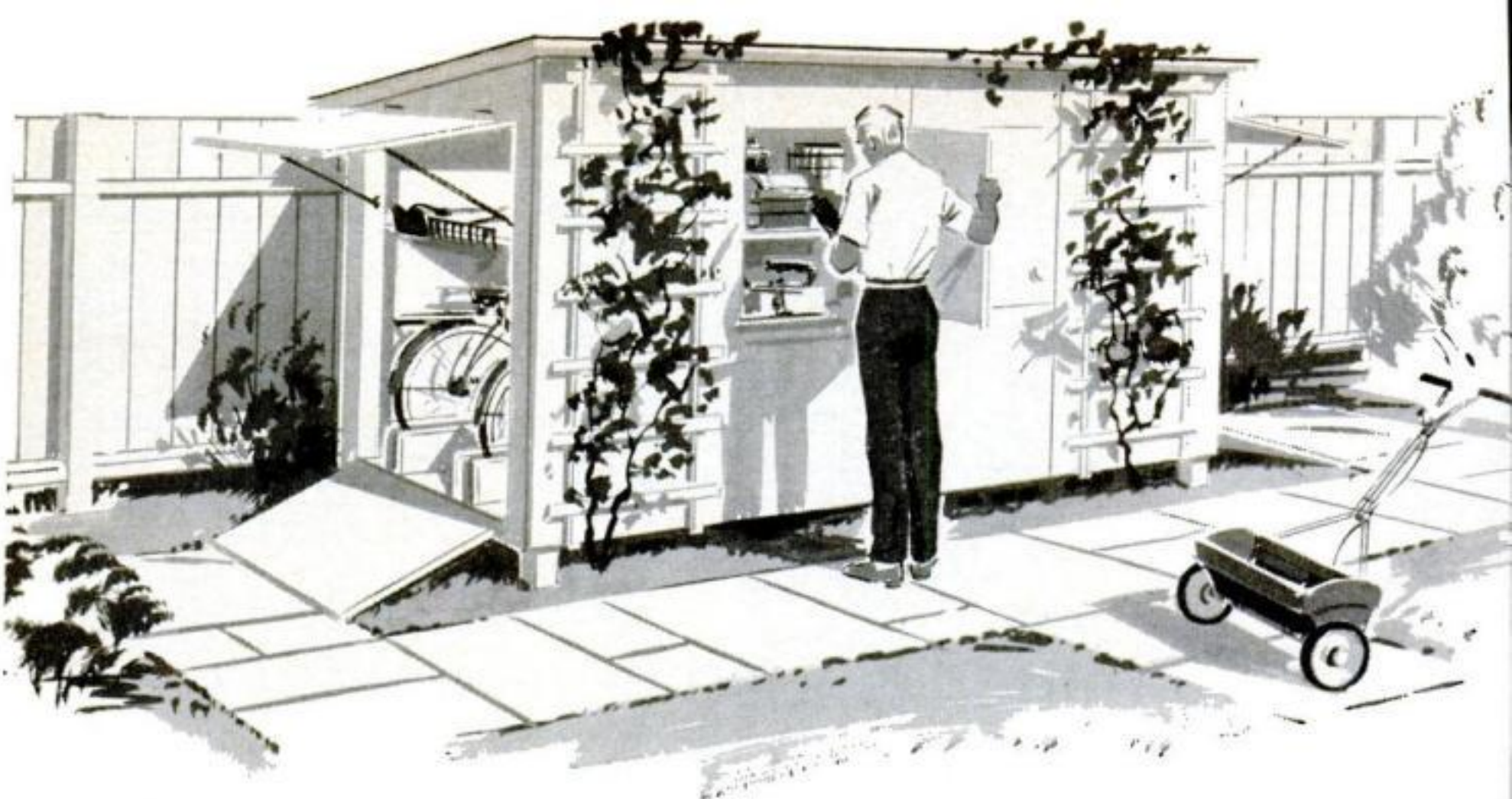
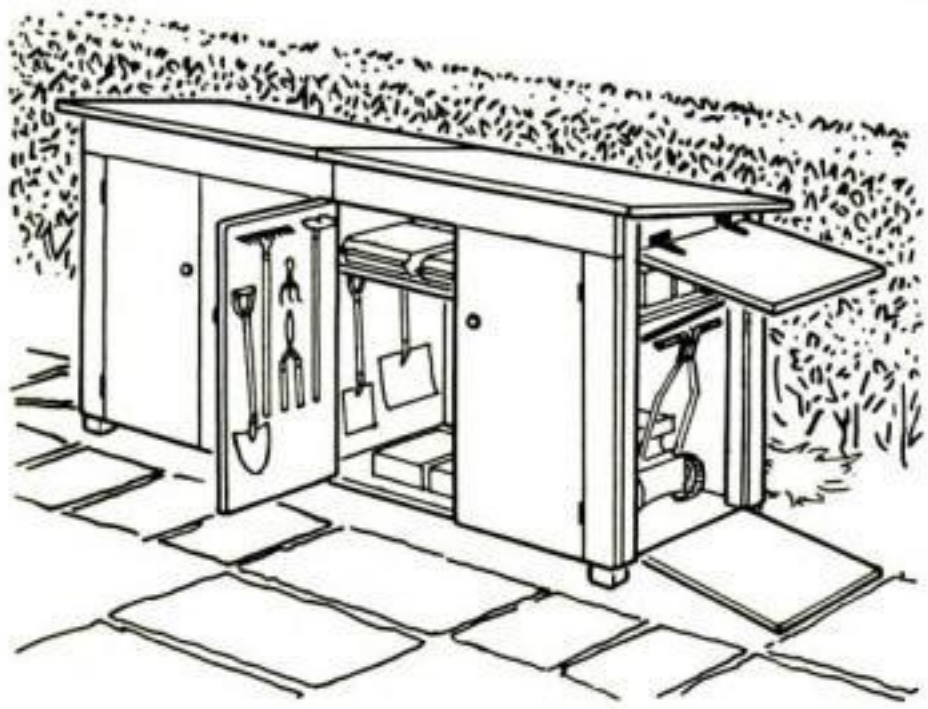




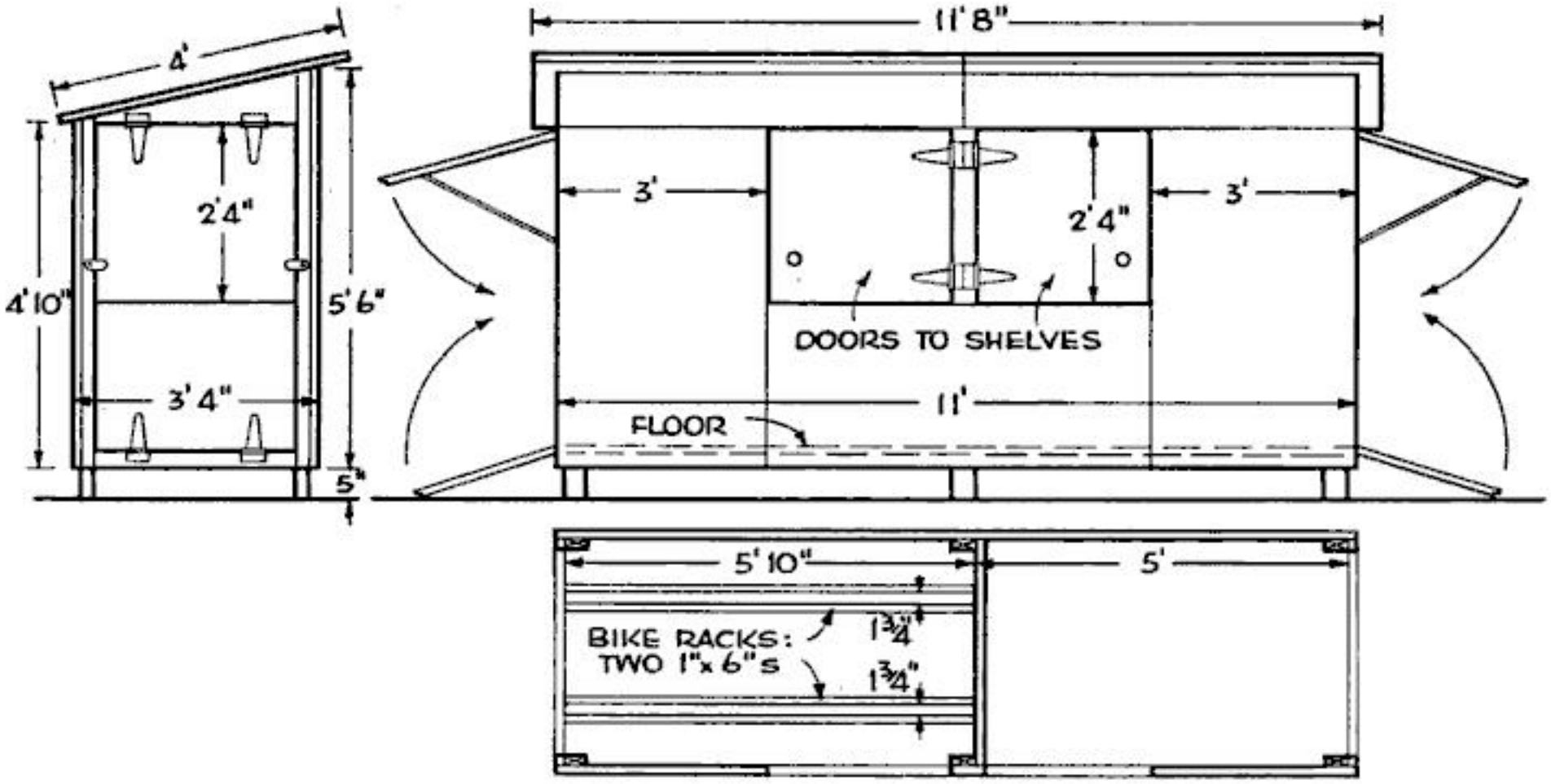
6 Two-Ended Bike and Mower Port

Bicycle-storage problems? The kids will enjoy having their own parking garage. Perhaps you also need to shelter a riding mower or a baby tractor. This shelter provides for two bicycles at one end and a mower or tractor at the other. It is shown above against a fence at a distance from the house, but it could just as well be

7 Storing Garden

Garden supplies such as peat moss, fertilizers, crab-grass killers, and grass seed are a problem. Where to keep them? This structure has six bins and 1½"-by-1½" steel angles set in concrete to support it. Because the pitch of the roof is great enough, composition shingles can be used over ¾" C-C outdoor plywood and building paper. The unit is decorative enough to go anywhere. Though it was planned for garden supplies, it would lend itself to housing other materials. The sketch at right shows how a two-by-two frame divides the

Urheberrechtlich geschütztes Material

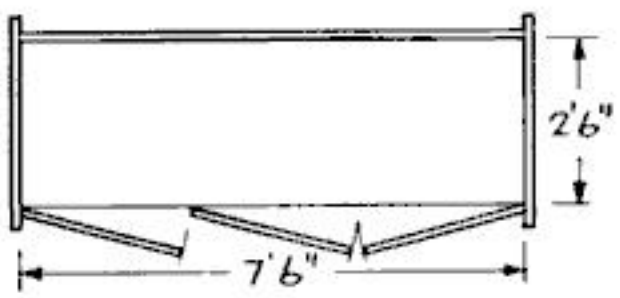


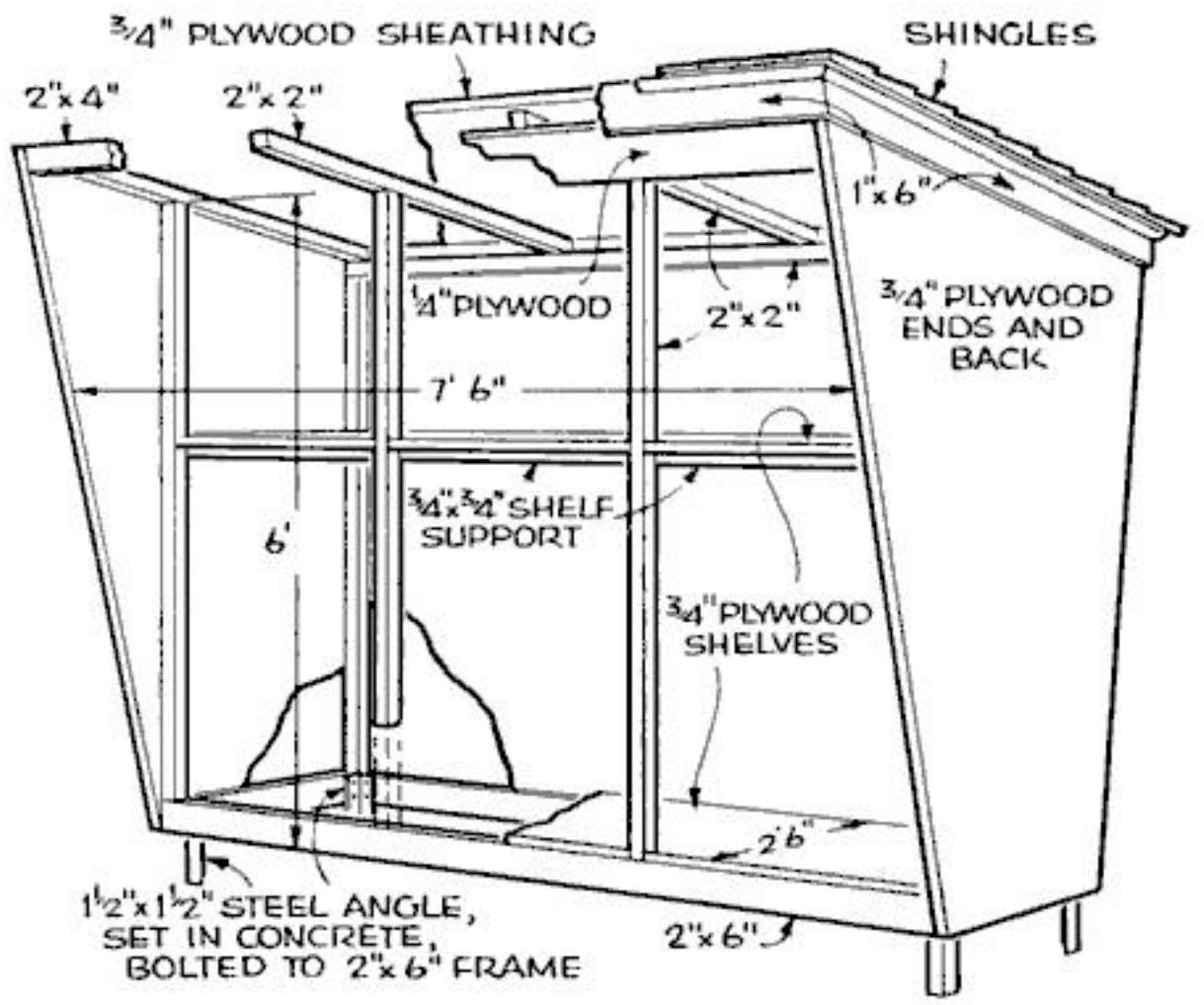
built beside the driveway or against the side or back of the garage.

Doors are made in two sections with rabbeted edges. The top-hinged upper door lifts up and is supported by metal rods. The bottom-hinged lower section drops down to form a ramp for bicycles and other rolling stock. One-by-six racks, a tire width apart, hold the bikes in place. Above these you can place shelves for a variety of supplies and equipment, reached through center doors or from the ends of the shelter. The alternate design in the smaller sketch has central doors where you can hang rakes, shovels, hoes, and other long-handled tools. Use ¾" exterior plywood for the walls, roof, shelves, and floor. Six two-by-fours embedded in concrete are both legs and framing for this structure. The roof was designed to be 4' wide so that full-width plywood could be used. In the drawings, the roof pitches from front to back, but it could as well slope the other way. It's advisable to use roll roofing over the plywood because of the center joint, but a batten over the joint would make the structure reasonably waterproof. The extra cost of roll roofing is worthwhile, however. Use a noncorroding metal drip edge. (Shelter is also shown on front cover of this issue of PS.)

Supplies

unit into six bins. Revise the frame, if you wish, to make smaller bins three high instead of two high. You might also wish to separate the bins with ½" plywood to store things like loose humus and peat moss. For this, slope the shelves from back to front, and place slats at front to hold the material.





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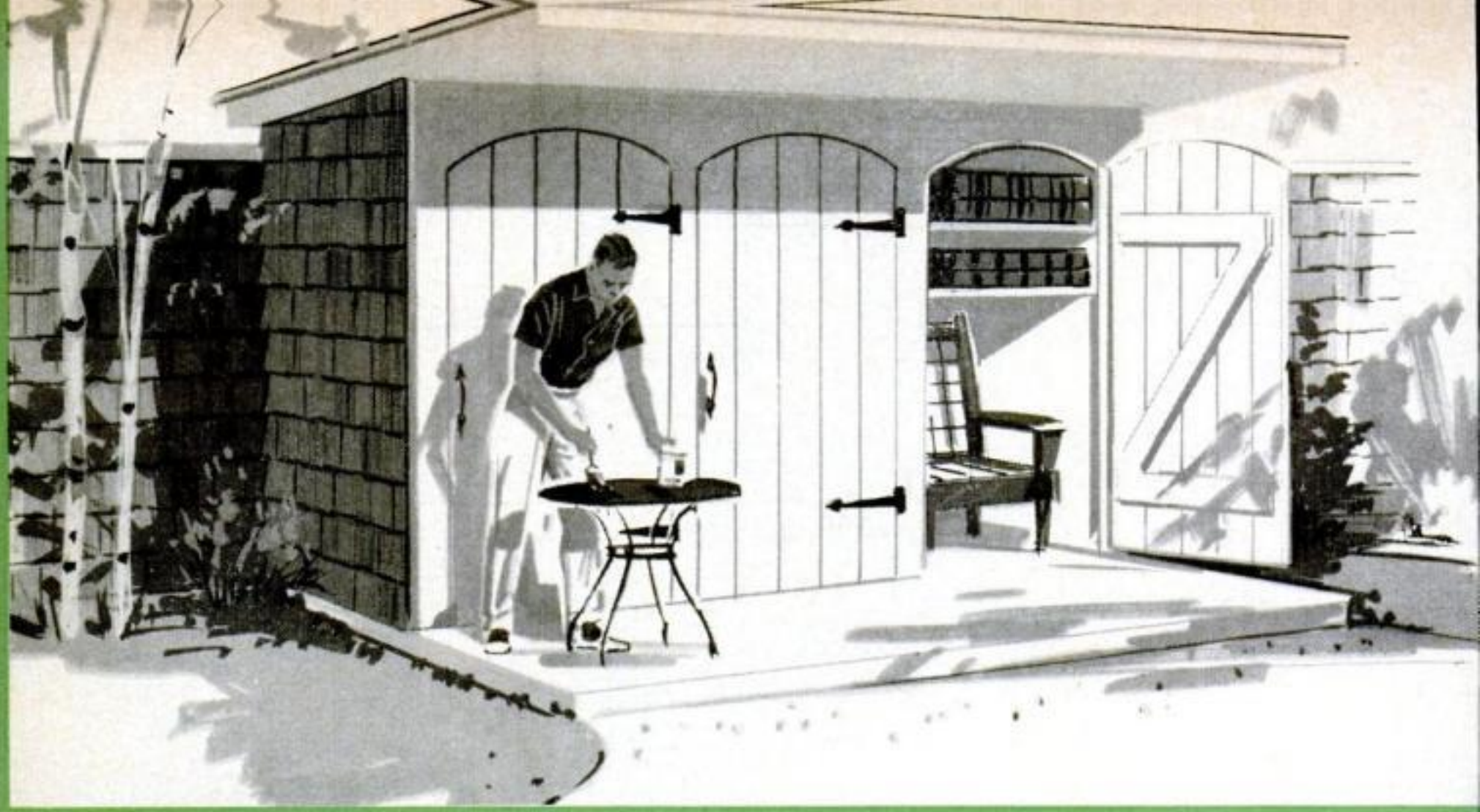
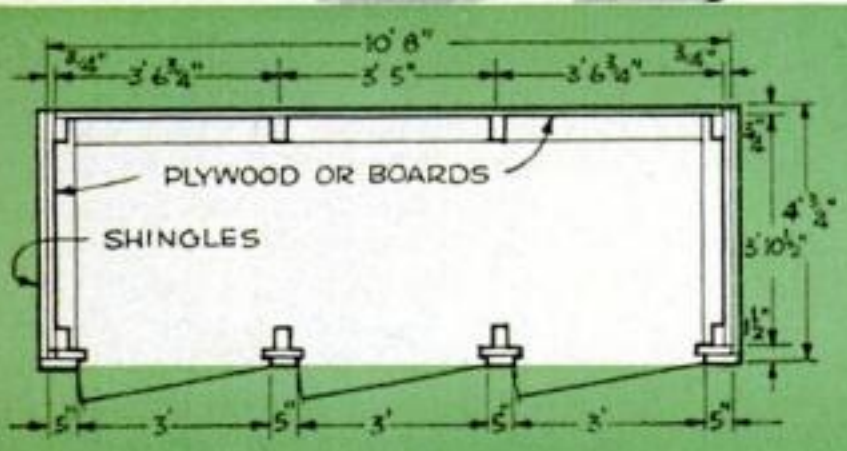
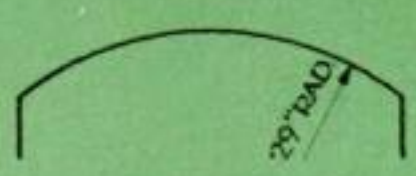
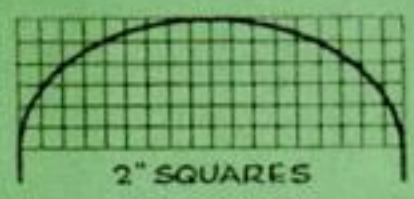








8 A Yard House, Detached or Free

Three-door storage center is designed to be built either against a house or garage or to be a building by itself. The structure is sized to store outdoor furniture, barbecue equipment, and other things to be used nearby. It could also be used for storing garden tools and supplies. It is 4′ deep so that single sheets of plywood can be used for the sides as sheathing or as the exterior finish. Door height is 6′ 2″. In pouring the concrete slab, make it 6″ above grade. For the shed roof, two-by-four rafters spaced 24″ on centers will suffice. Cover them with roofers or plywood. Cover this with roll roofing, first applying a noncorrosive metal drip edge around the edge. And at either end use a small screened louver up under the roof for ventilation.

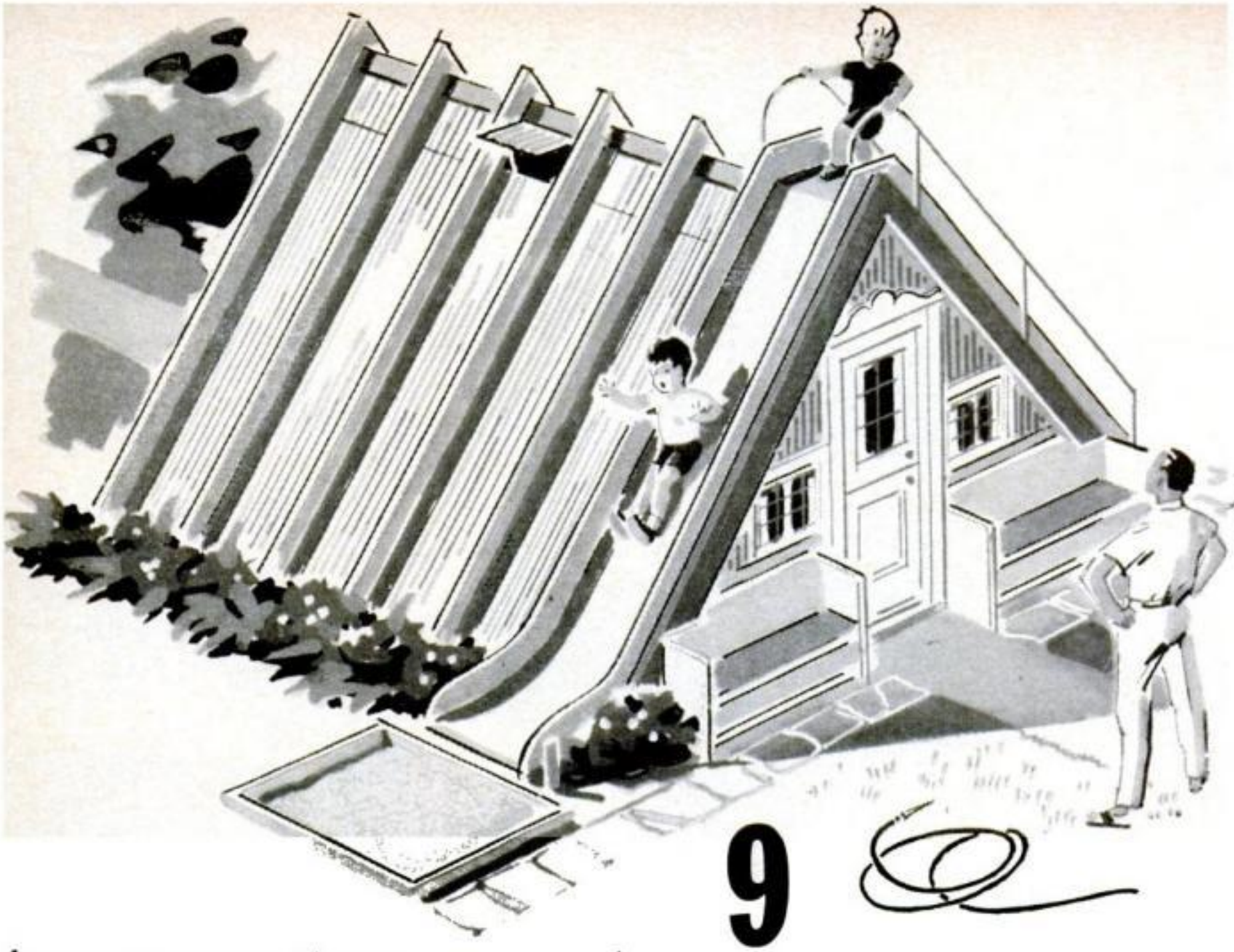
The sloping roof with an off-center ridge on the structure at right gives extra headroom in the front. Its depth was planned to take a riding mower head-on. Hence the ramp in the slab at the front. The rafters can be covered with roofers or C-C plywood over which you can use shingles. Wood shingles are pleasing in appearance and will last indefinitely. Durable woods for shingles are red cypress, red cedar, or redwood. They can be stained or left untreated to weather. Shingles can also be bought predipped in stain. However, if wood shingles exceed your budget, there are many easily applied composition shingles that are both durable and colorful. Manufacturers give explicit directions on how their roofing materials should be applied for best results.

The framing drawing at the top of the facing page and the other drawings give information and dimensions for building this yard house and for cutting the arched doors. Vertical boards are suggested for the exterior. Every inch of space up to the one-by-six ridge is potential storage space. Shelves and bins should be planned to meet your own needs. Also above is a cutaway drawing of the square cupola. Inserted in each side is a metal louver you can buy. After the cupola has been assembled and roofed, it can be toenailed to the roofers. After that, the roof underneath should be cut away. You can also buy well-designed and decorative metal cupolas complete. These take little work: they need only be secured in place.

CONTINUED

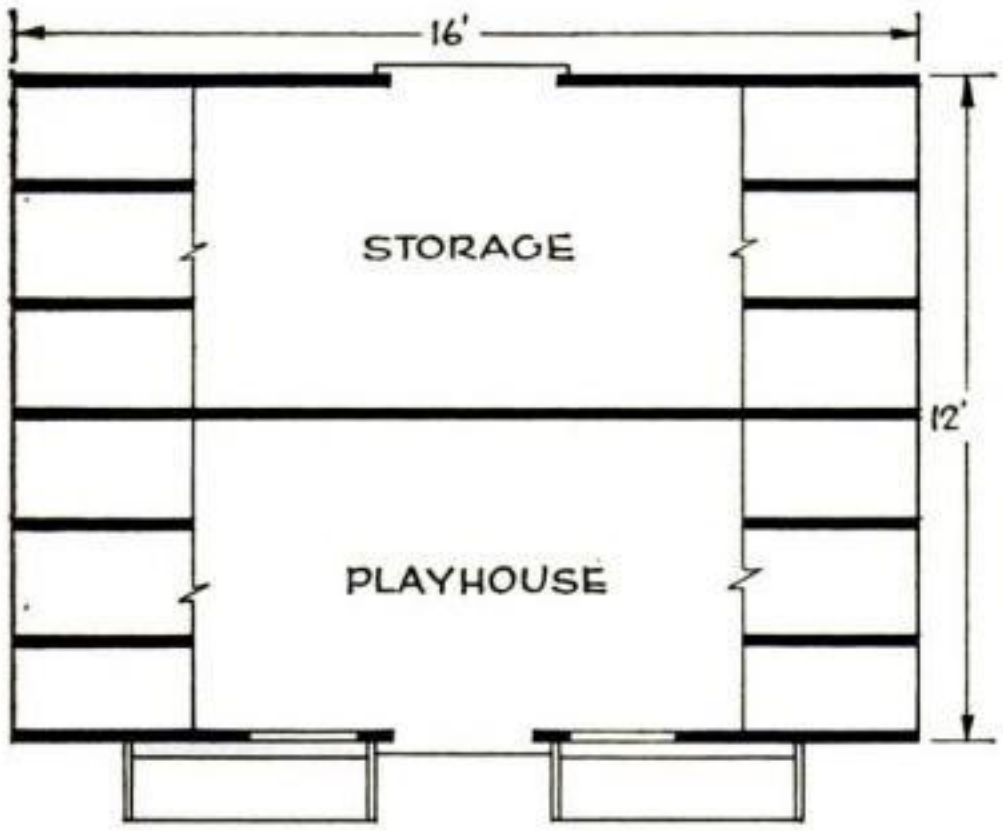
Urheberrechtlich geschütztes Material

SHINGLES
SHEATHING
2'9"
2"x4"
1"x6"
1"x4"
5'5¼"
1'6"
℄ RIDGE
7'2"
6'2"
2"x4"
5'8"
CONCRETE
GRAVEL
6"
4"
4"
EXCEPT WHERE OTHERWISE NOTED, ALL FRAMING MEMBERS ARE 2"x4".
1"x6"
1"x4"
1"x4"
1"x4"
1"x4"
2'9"
5'8"
3'
3½"
7'2"
½"x8" ANCHOR BOLTS
CONCRETE FLOOR AND APRON
½" DIA. IRON PINS
½" PLYWOOD
STANDING SEAM
METAL
2'
2'
2'
10'8"
¼"
5'6¾"
3'5"
3'6¾"
¾"
5½"
4'11½"
5½"
5"
3'
6"
3'
5"
3'
6"

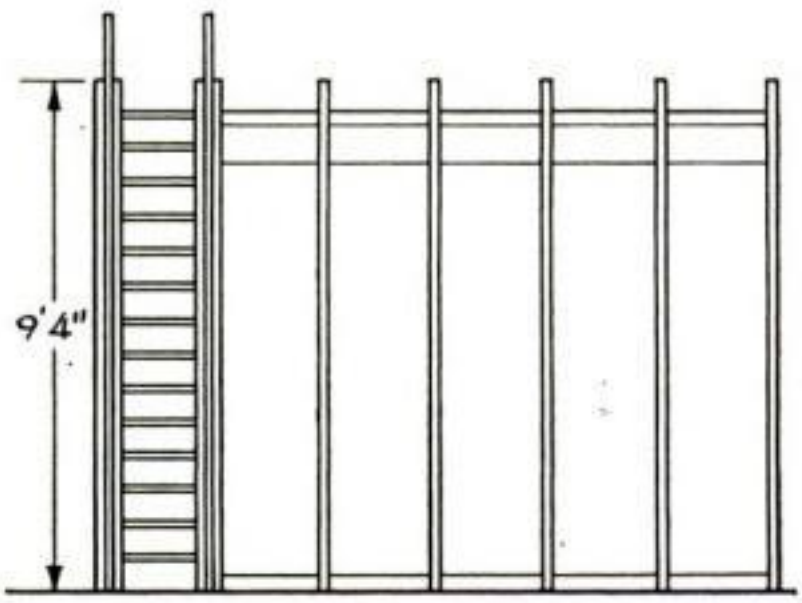


9

For the Kids, Too



A combination playhouse and storage center is a great idea. The A-frame members should be two-by-sixes embedded in concrete. Translucent corrugated plastic is suggested for use between frames; it gives ample light to the interior. Note the ventilators at the apex between A frames and the noncorrosive metal cap to cover the plastic joints. Across the A frames on the inside, nail a couple of one-by-fours horizontally to hold the frames. Under the slide, use ¾" plywood for rigidity. For ease, you can size shelter to suit a commercial slide. ■ ■



Urheberrechtlich geschütztes Mate

Newest wrinkle in fences consists of corrugated aluminum panels mounted on one-by-four rails and four-by-four posts. Now available at building-supply dealers, the panels are made by the Aluminum Company of America for both fences and roofs.

HOW TO BUILD Tall Fences for Privacy

By W. B. Eagan

A HIGH fence around part or all of your property will shut out the distractions of the neighborhood and give you your own private retreat in the sun.

Select a design that will harmonize with the architecture of your house and blend in with the landscape. Be certain, before you start, that you know where your property lines are, and check for any local ordinances that may affect what you can build and where some zoning laws ban fences.

If you do not plan to paint the fence, choose a wood that is naturally resistant to decay—cedar, redwood, locust, or cypress. For the posts, use these decay-resistant woods or any other that has been pressure-treated with preservative.

Use nails, screws, and other hardware that will not spot or streak the fence. Zinc-coated nails are strong and will resist corrosion for years. Aluminum nails will prevent streaking for the life of your fence. When you use aluminum nails in hardwood, drill pilot holes first to prevent bending.

The post that is set incorrectly is the weak link in any fence. Frost will heave it loose unless its bottom is set below the local frost line. So you've got to dig. The minimum is 24″. In the northern U.S. 30″ or 36″ may be better.

Because of the strain that gateposts must stand, they should be larger and go deeper than the others. If fence posts are 4″ by 4″, it's logical to use gateposts 6″ by 6″. Rails usually are two-by-fours.

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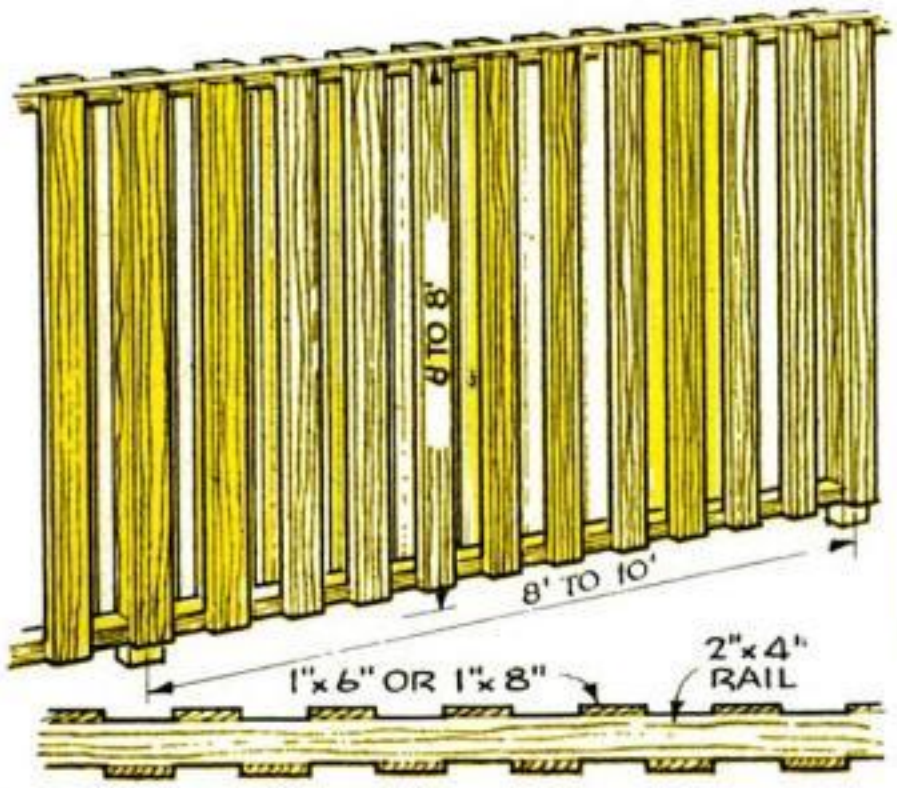
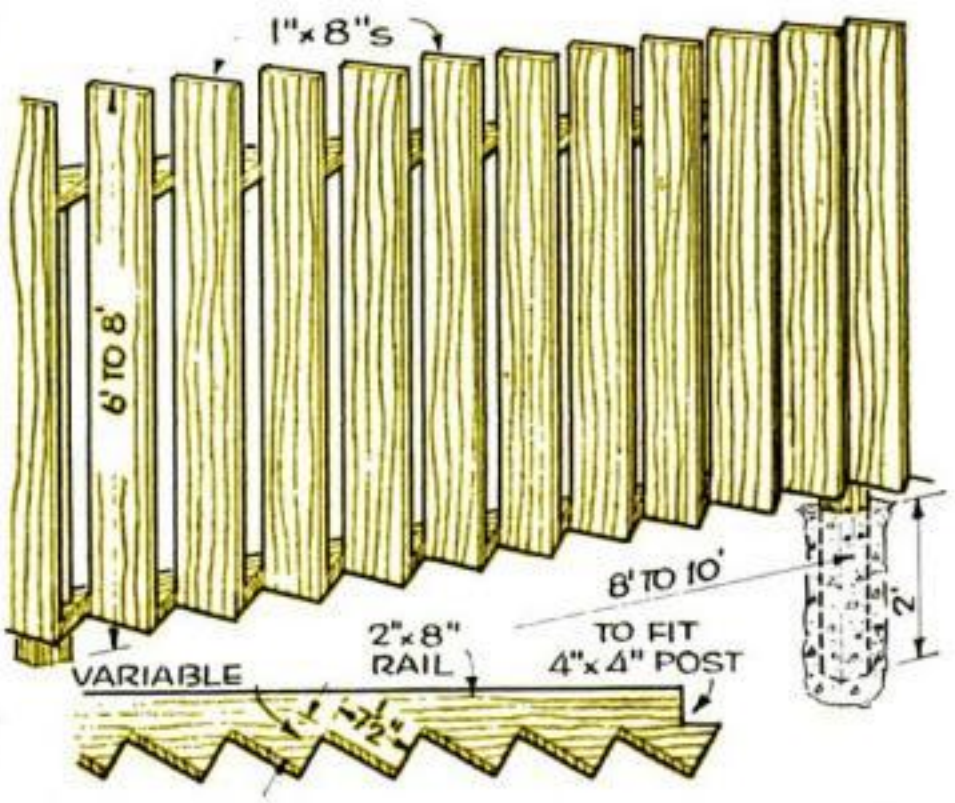
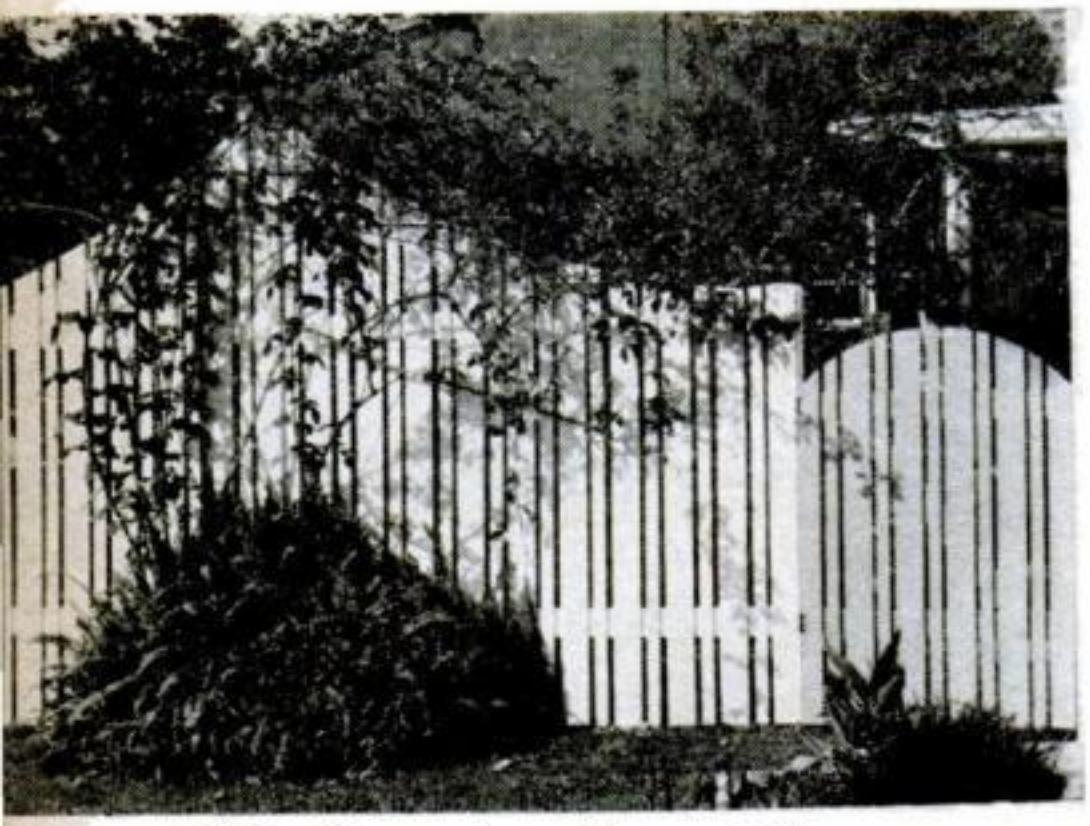
Urheberrechtlich geschütztes Material

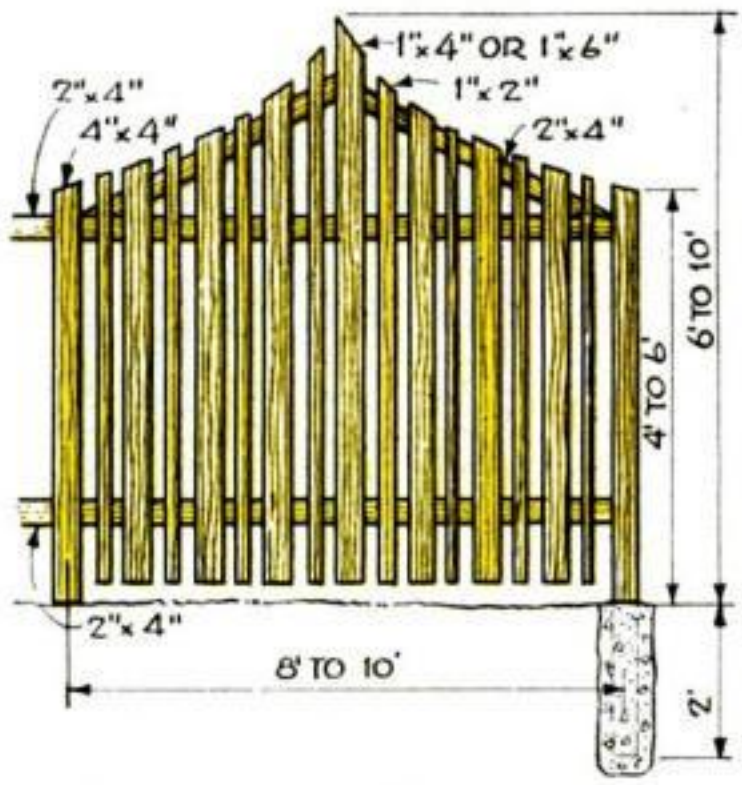
Two board fences that give ventilation as well as privacy



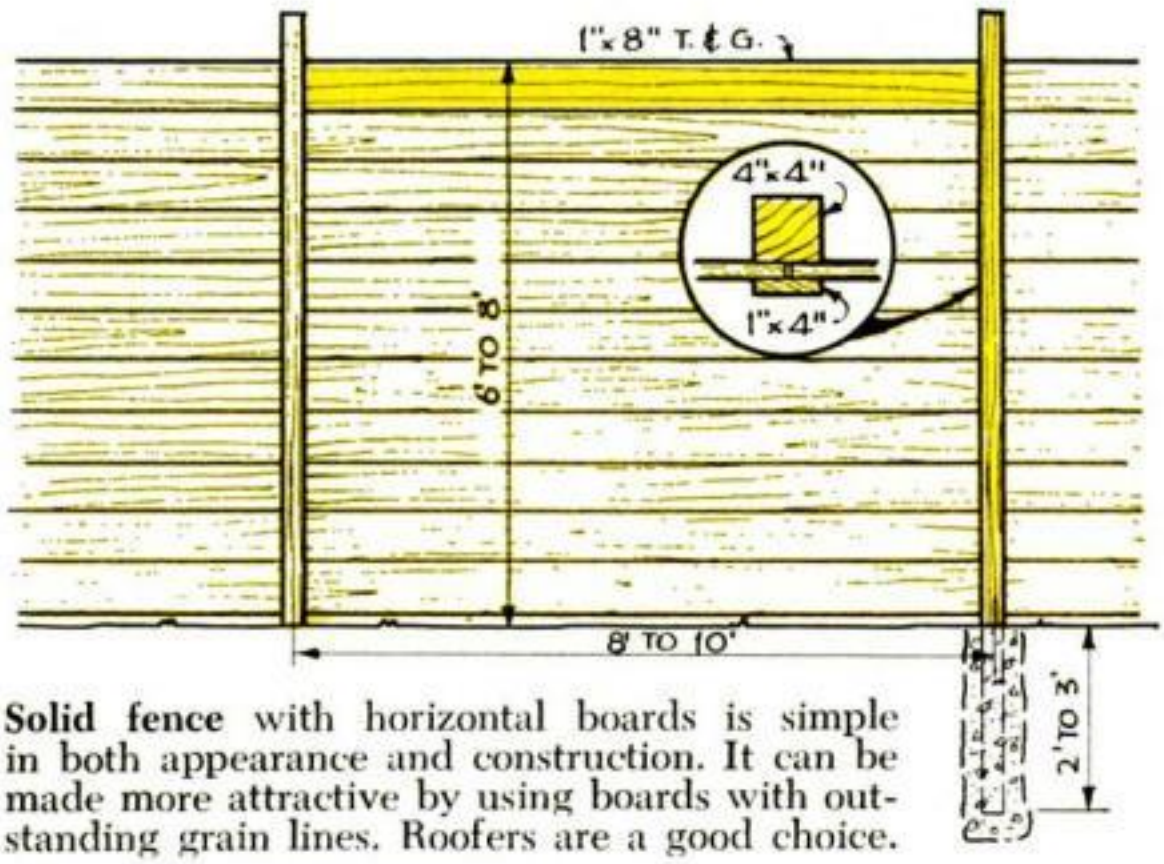


Vertical boards of these designs let breezes through but still give privacy. Alternating the uprights on opposite sides of the rails as in the sketch above performs both functions nicely. The sketch at right shows how to cut two-by-eight rails for one-by-eight verticals, which actually measure 7½" wide. Reducing the variable dimension will reduce gaps in fence.



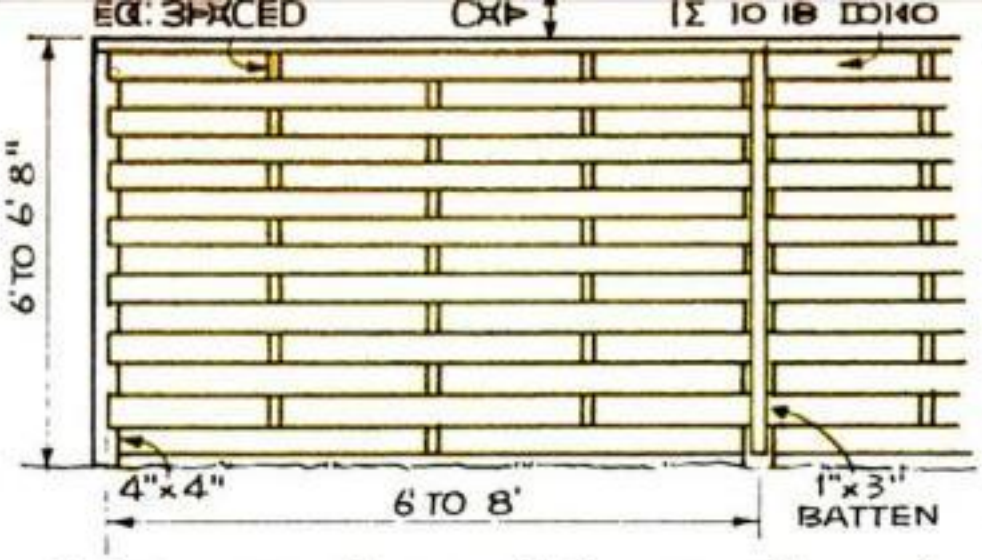


Picket fences in modern variations may sometimes give you privacy. The one shown here uses pickets of two widths. Lay out the curve on the top after the pickets are nailed in place.

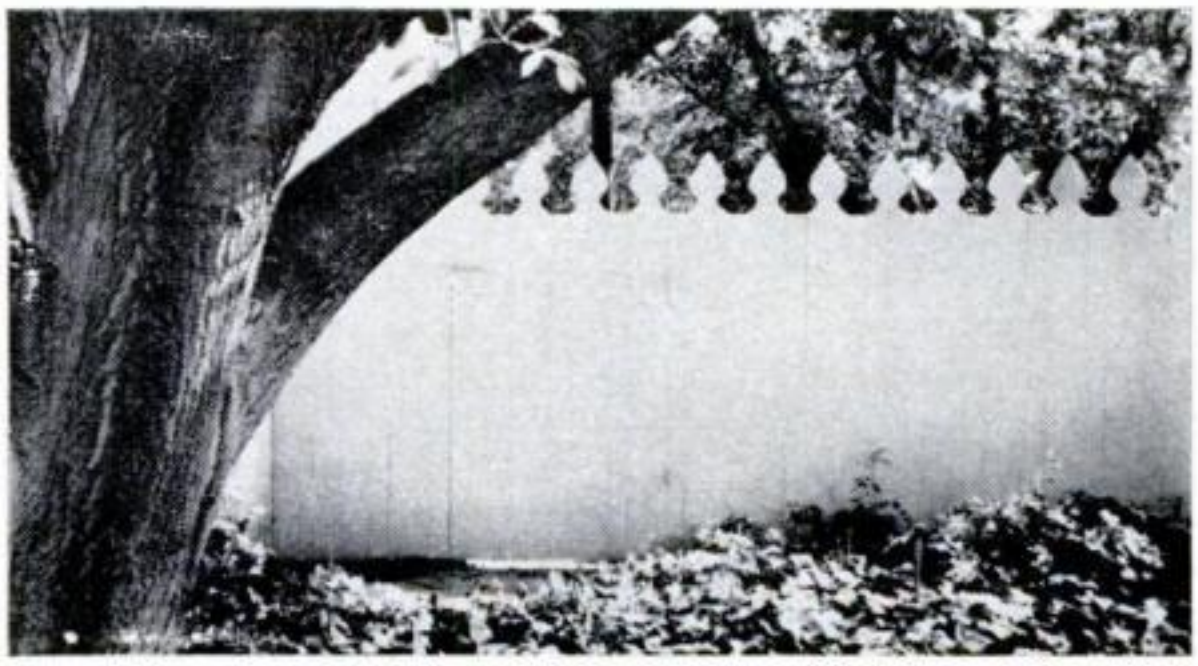


Solid fence with horizontal boards is simple in both appearance and construction. It can be made more attractive by using boards with outstanding grain lines. Roofers are a good choice.

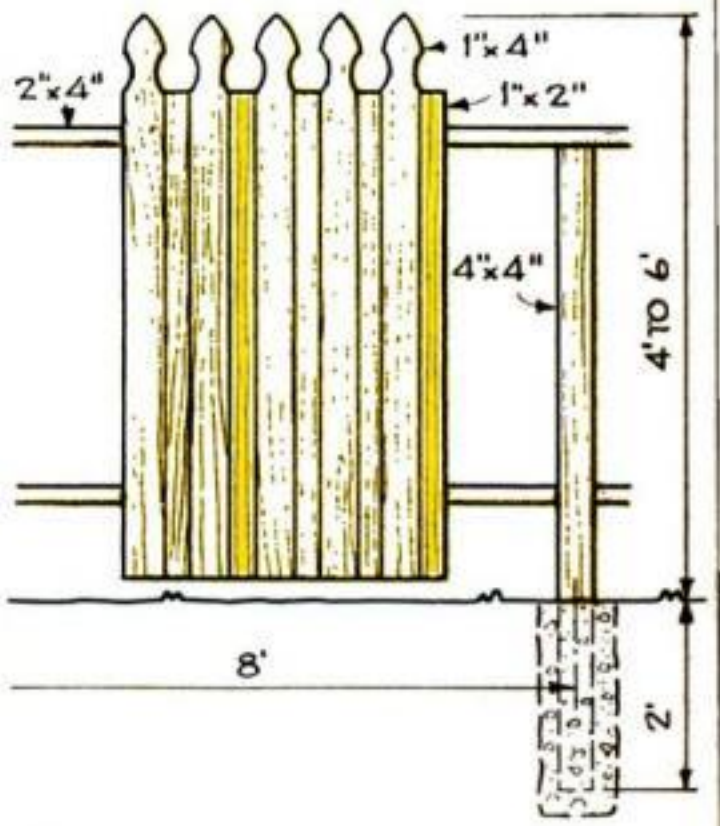
Urheberrechtlich geschütztes Material



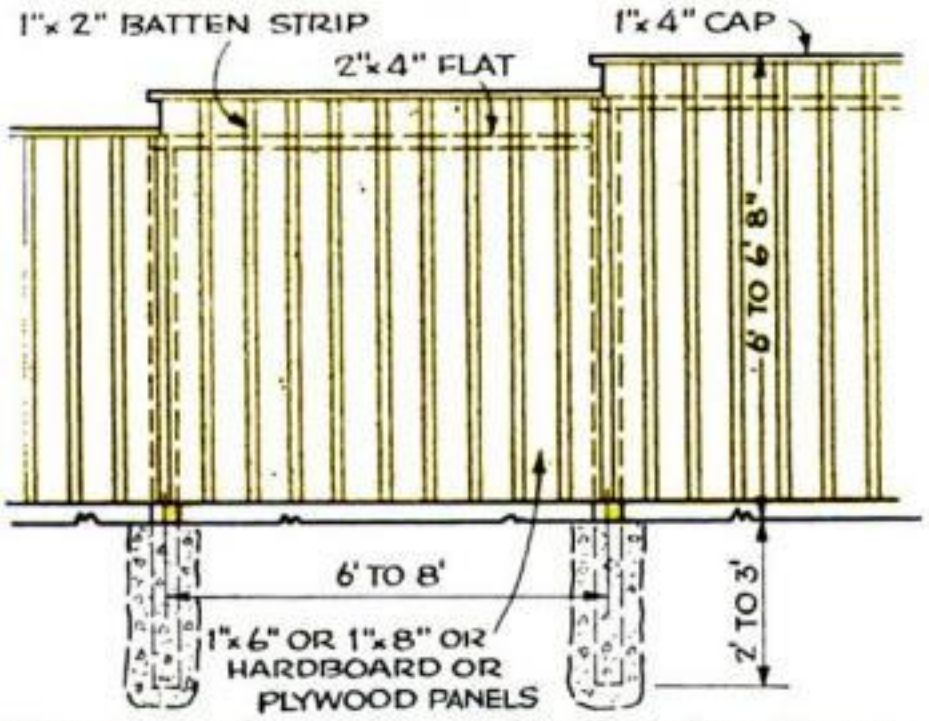
Basket weave gives ventilation as well as privacy. The thicker the vertical spacers, the greater the shadow effect produced on the weaving, and the greater the air flow through the fence.



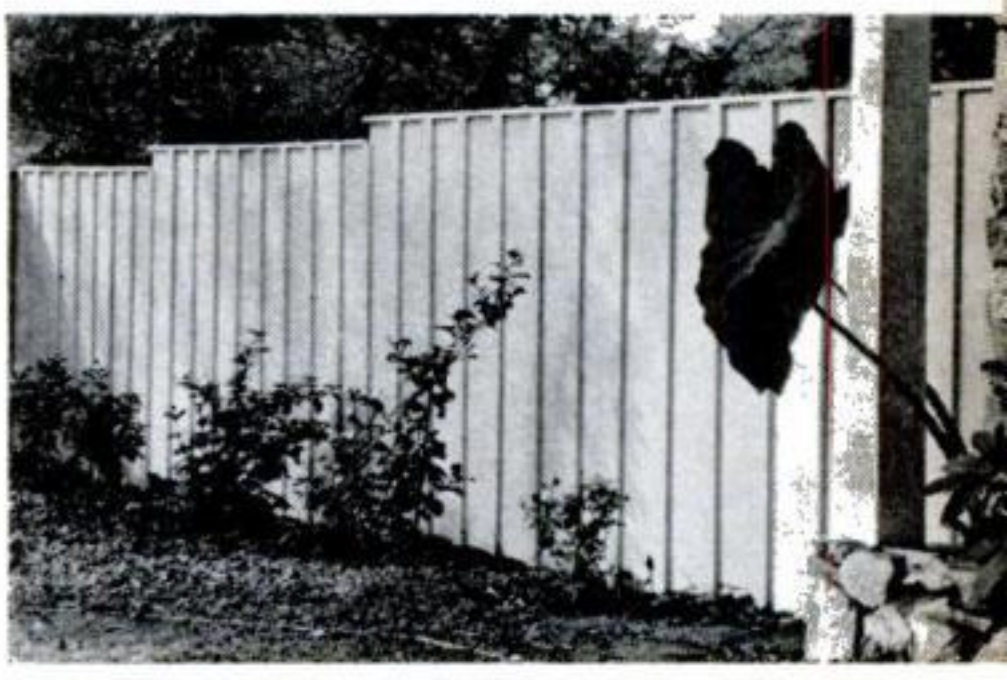
A picket top improves the looks of this solid board fence. The tops can be cut with a saber saw. The fence offers considerable protection against intruders; it's a tough one to climb over.



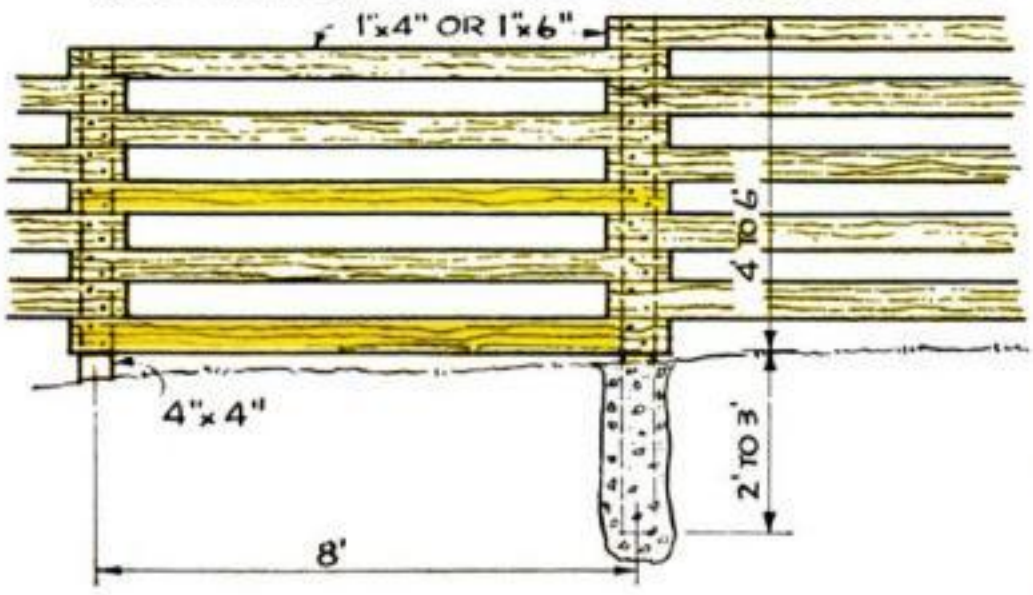
Two fences that are specially designed for a sloping lot



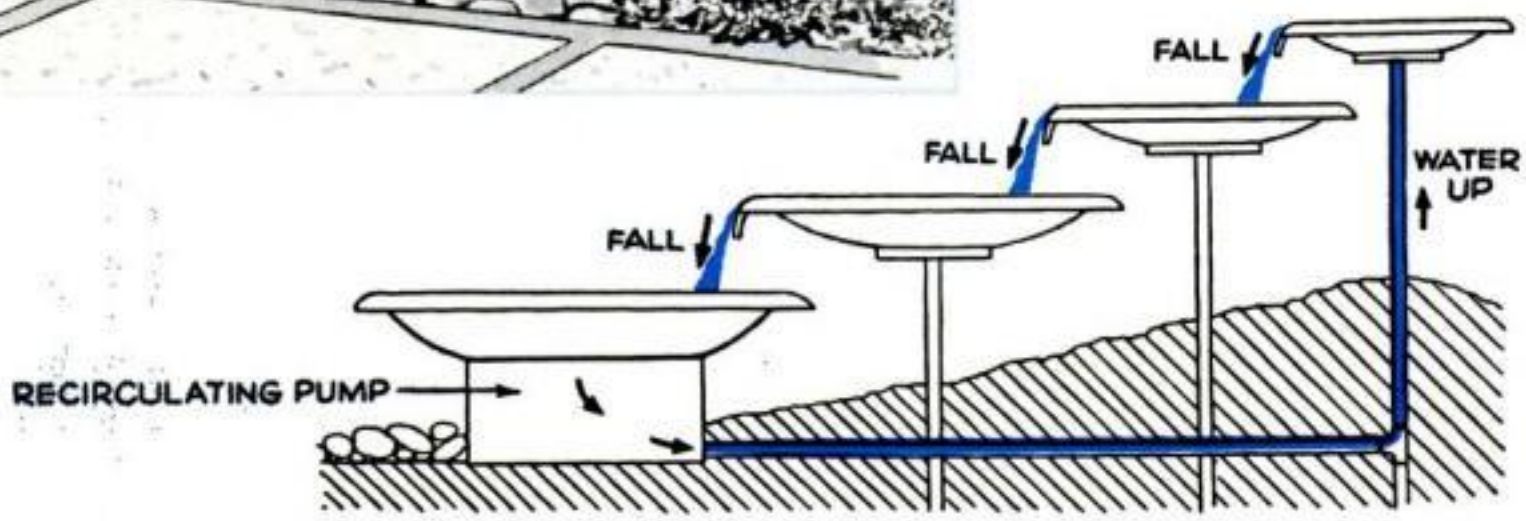
Big panels of ⅜" tempered hardboard or ¼" outdoor plywood—as well as one-by-sixes or one-by-eights—can be used for a fence like this. Batten strips can be used in either case.



A rail fence that also serves as a trellis often gives privacy, too, when the vegetation is in leaf. Alternating the horizontal rails is an ideal arrangement for a fence on a hillside. ■ ■



Picturesque cascade comes from nowhere, goes nowhere, yet flows endlessly. The secret is a recirculating pump in lowest pool that carries water back up to highest pool. You can buy bowls ready-made for the job or apply the same idea to a series of homemade pools stepping down from one level to another. Bowls shown here, of fiberglass, are sold by Zeno Plastics Co., Gardena, Calif.



Want a real eye-popper for your back yard? A recirculating pump is the secret of building—

A Cooling Waterfall

A GARDEN fountain or waterfall used to be a luxury reserved for large estates and usually only those fortunate enough to have a natural source of water on the property. Today all you need is a hole in the ground, big enough to hold a few bathtubfuls of water, and a faucet at the house to fill it from. A tiny electric pump will squirt the water out of a nozzle to make a shimmering fountain, or pump it up to a spillway to make a splashing waterfall. The pump will keep recirculating the same water over and over so there's no waste and no problem of where to drain it.

This modern development in home fountains and waterfalls has led to a whole new kind of yard decoration—landscaping with water. A gentle, rainlike spray or a softly gurgling stream adds a pleasant, restful scene to any garden. On hot summer days, it has the psychological effect of making it actually seem cooler.

Small recirculating pumps sell for $15 to $80. These are usually submersible and can be placed right in your pool. The pool can be simply a shallow hole lined with plastic film to make it watertight. You don't need to put in permanent plumbing or wiring unless you want to. The pool can be filled with a garden hose, and the pump can be plugged into an outdoor outlet at the house.

Kits containing everything you need for

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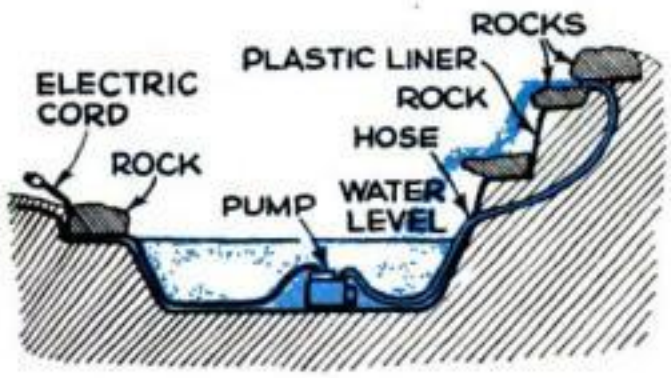
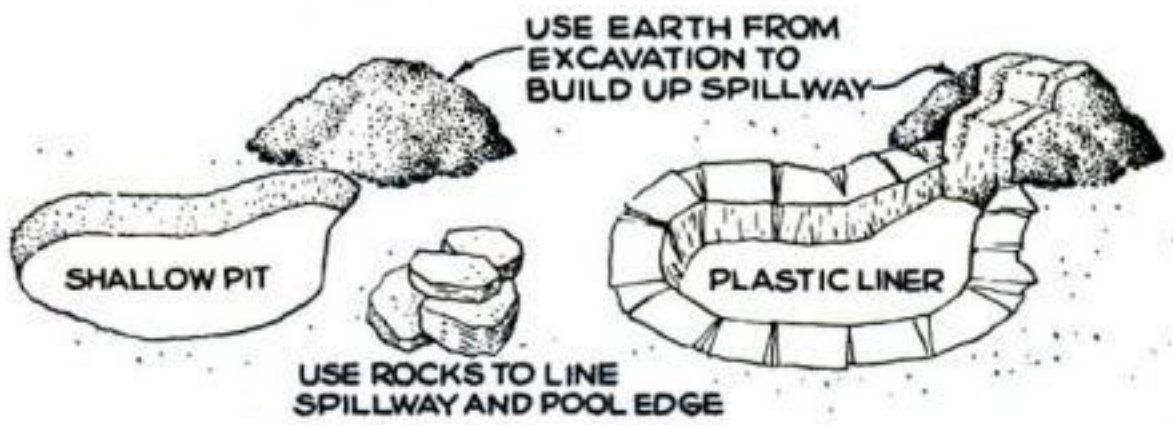
Urheberrechtlich geschütztes Material



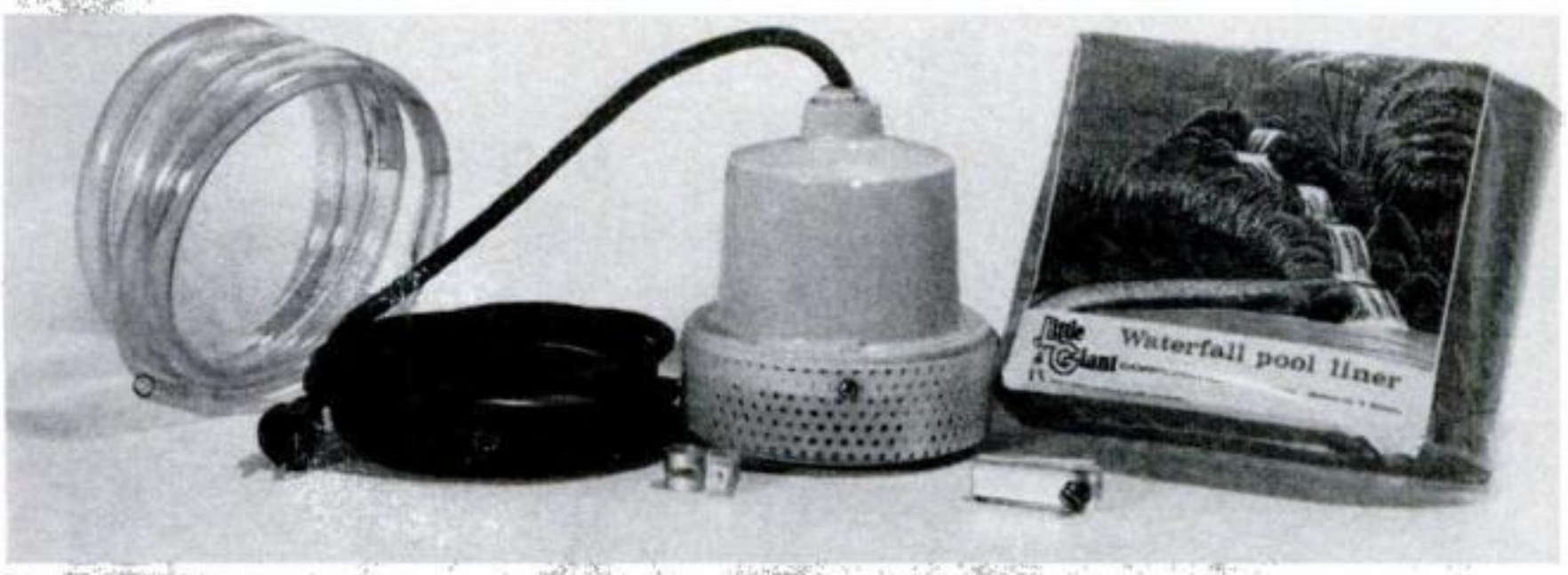
Simple waterfall requires only a few rocks arranged to make a spillway above a small pool. A submersible pump in the pool pipes water to the top of the spillway and keeps recirculat.ng it. If there is no natural slope for the spillway, build one up with earth and stones, disguise it to look like part of a rock garden. The pool is merely a shallow pit lined with plastic film. The edges of the plastic are hidden under earth and stones at the pool's rim.



PS HOME IMPROVEMENT

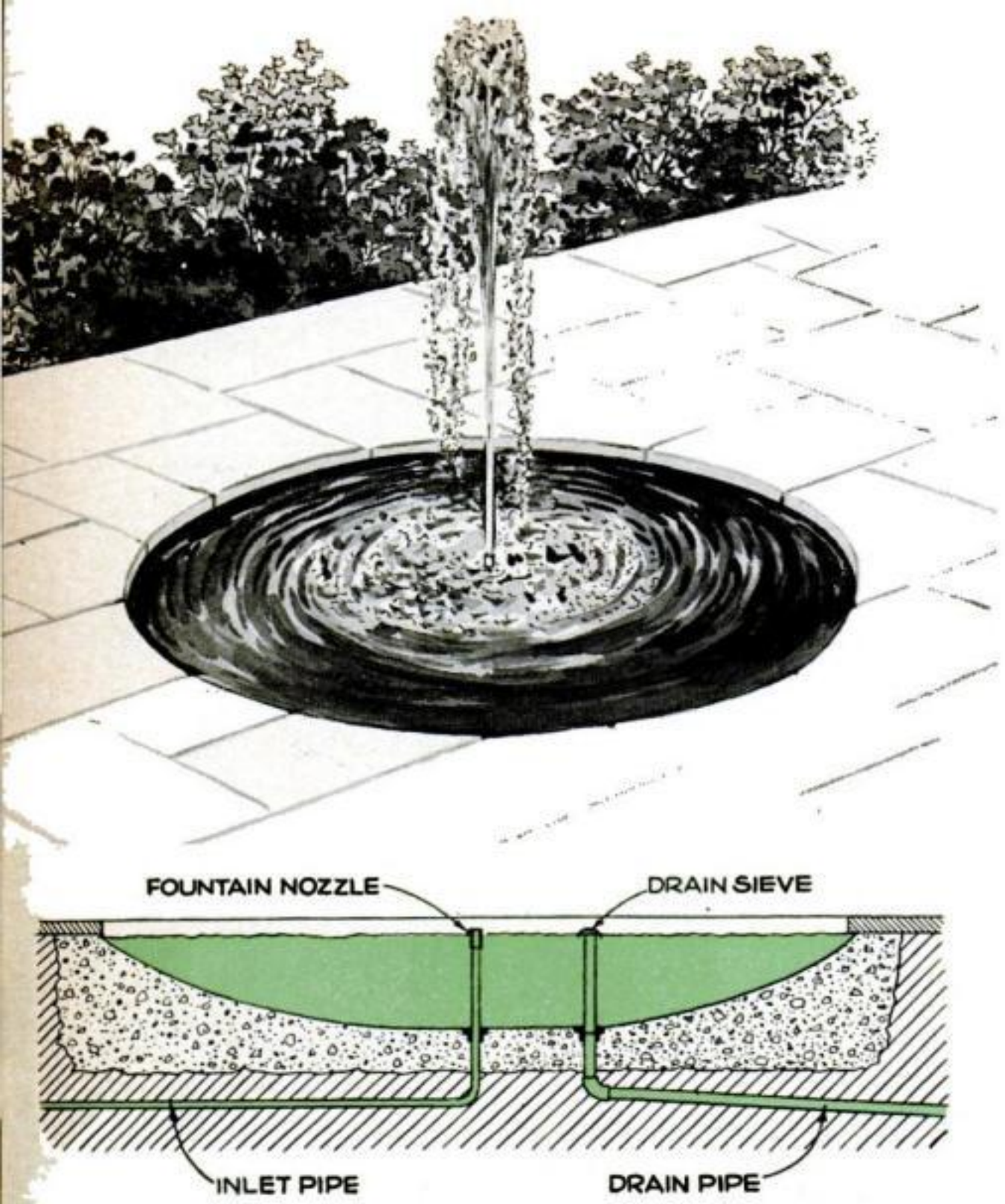
or Fountain

By John Brimer



Packaged waterfall: Kits make it easy to build your own fountain or waterfall. This one, sold by Little Giant Pump Co., includes a pump, tubing, and plastic pool liner: costs about $35.

Urheberrechtlich geschütztes Material



Saucer-shaped pool takes little digging, can be concrete, as here, or simply a plastic liner. The fountain can be fed from an open-air pump connected between the inlet and drain pipes, or from a submersible pump placed right in the pool.

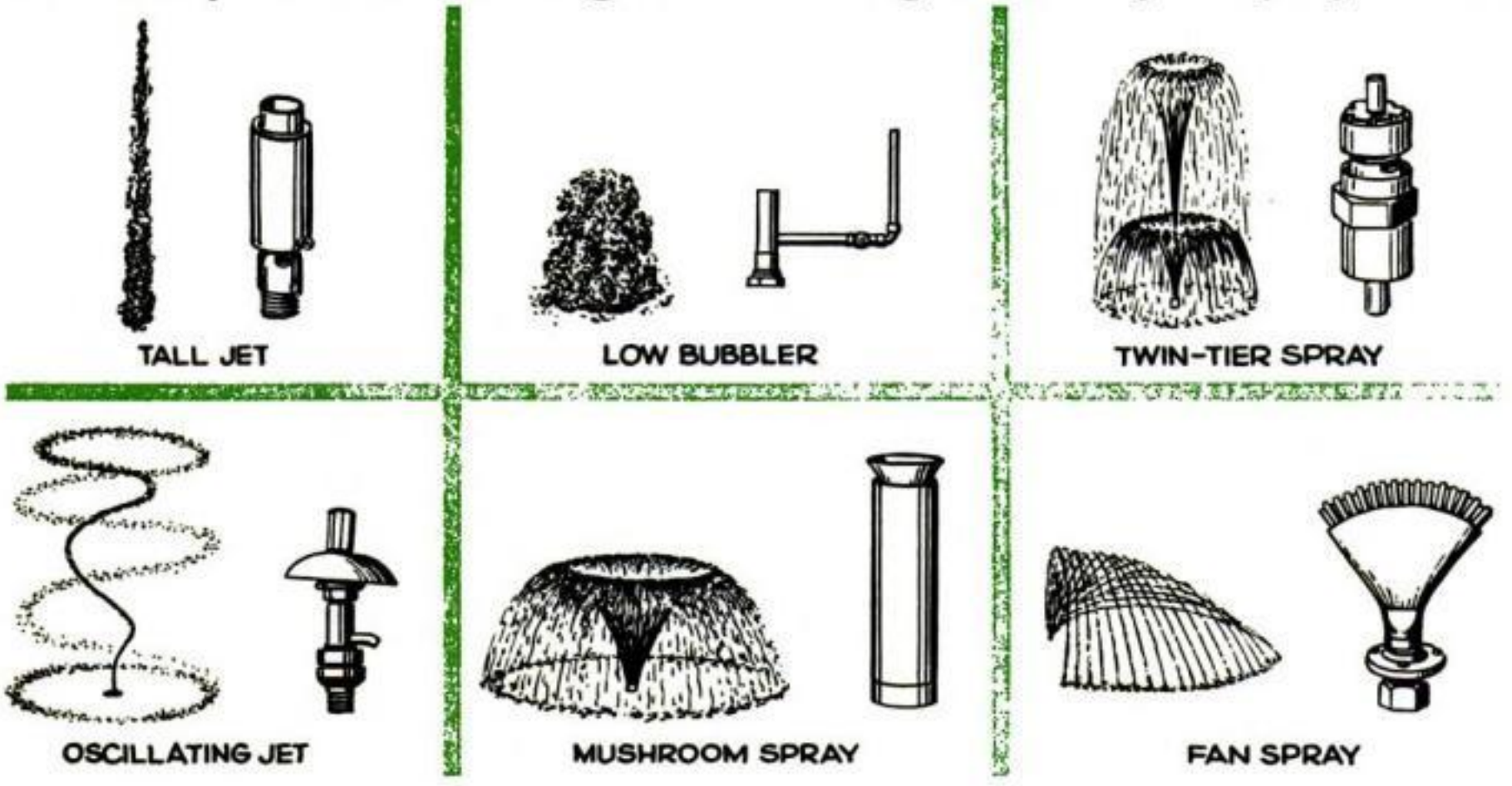
a waterfall start at less than $20 and go to about $70. These include a pump, plastic pool liner, and tubing for piping water to the top of the fall. If you decide on a fountain, you usually buy the parts separately, as there are many types of spray nozzles to choose from. Underwater lights are also available separately for creating dramatic effects at night.

Choosing a pump. The pump to buy depends on how much water you have to move and how far. The higher the waterfall or the bigger the fountain, the more pump capacity you'll need. Pumps are rated according to the quantity of water they'll handle in gallons per hour and the maximum height of water they will lift in feet.

If you're planning a waterfall, measure the vertical distance from the pool to the top of the spillway and select a pump that has the capacity to handle this height. If you buy a kit, the instructions will tell you how high to make the spillway.

[*Continued on page 184*]

You can pick a nozzle to give the falling water any shape you want



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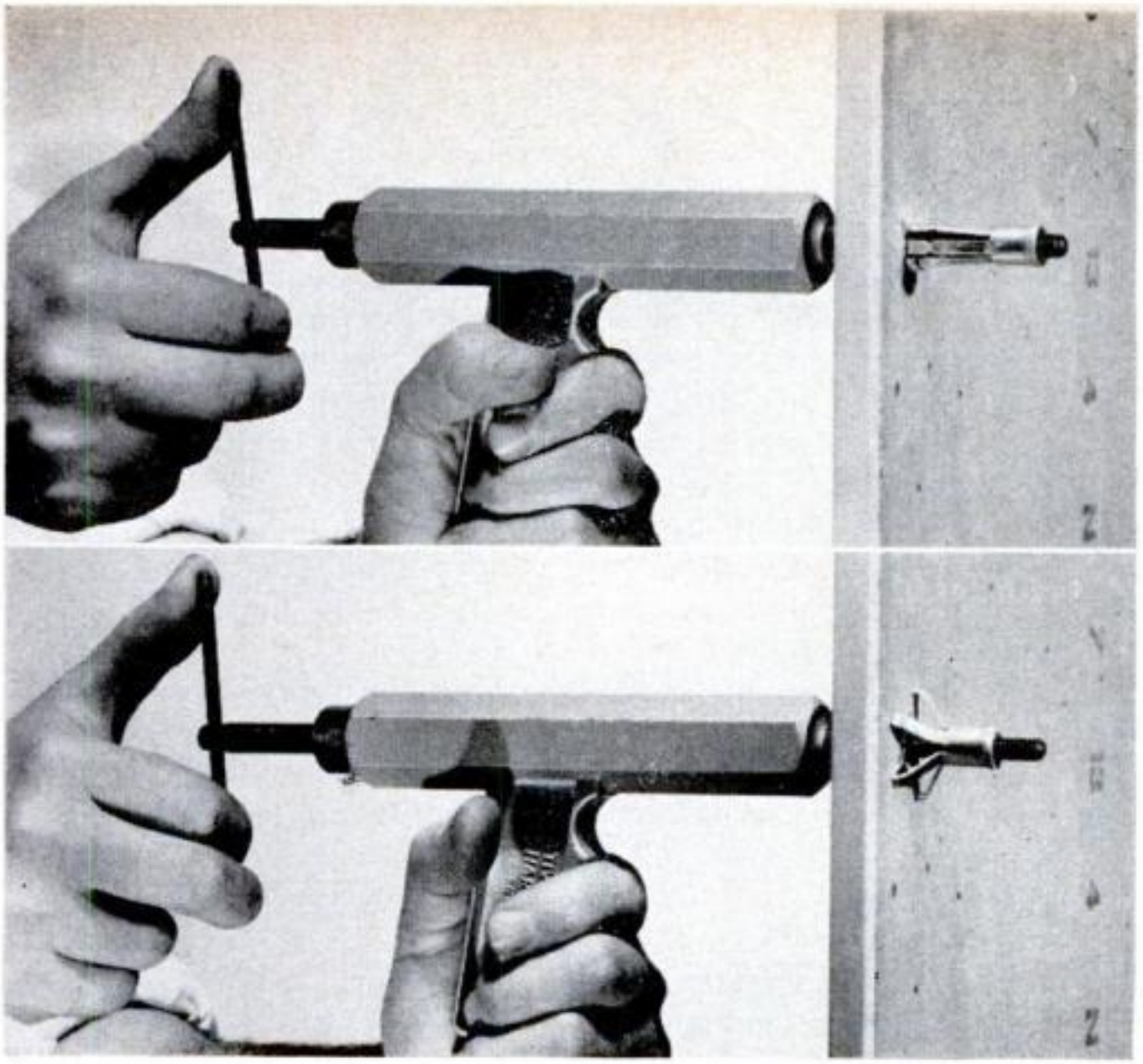


Turning the handle retracts the threaded stem like a jackscrew, spreading the anchor's legs until they lock tightly.

Phantom views show how the threaded stem inside the tool works. At top, the stem is slipped through two metal strips and a rivet is screwed on. At bottom, the stem is retracted with the handle, squashing the rivet to join the two strips.

PS TOOLS

Now it's a cinch to clinch rivets and wall anchors

A FEW twists of the handle on this pistol-like tool make quick work of setting rivets and wall anchors. The handle retracts a threaded stem that squeezes up the body of the rivet or anchor to clinch it tight. Because the fastener is pulled snugly against the tool nose, it can't twist loose in the hole, as sometimes happens with a screwdriver.

By using different adapters, the tool can handle all types of standard expansion anchors, threaded rivet nuts, and Pop rivets. The tool itself sells for $11.95 from Creative Engineering, Inc., Box 262, Sharon, Mass. A kit consisting of the tool, two sizes of stems, and an assortment of rivets costs $14.95. Additional adapters are available separately.

Urheberrechtlich geschütztes Material

PS HOME IMPROVEMENT

An architect offers you sound advice on—

Choosing the Right Windows

By G. K. Geerlings, A.I.A.

THE introduction of large areas of glass to create continuity between indoor and outdoor living space has been a major contribution to our more recently built homes.

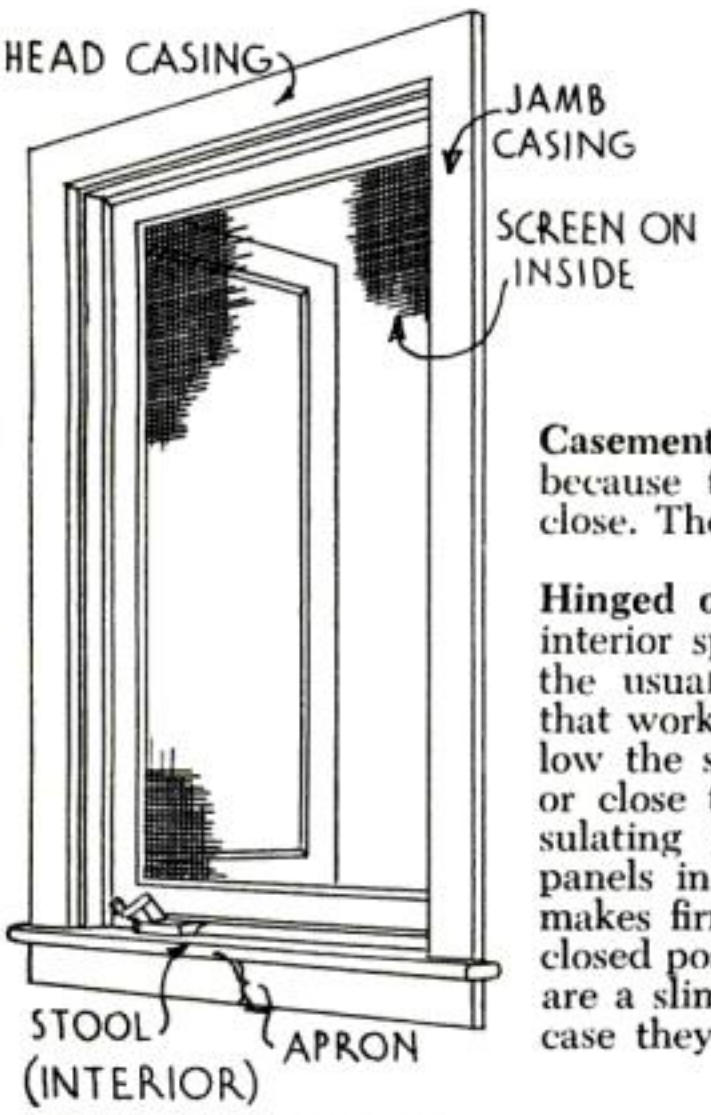
This is good if wisely used. A "glass wall" facing a rear garden, a side patio, or other area always adds to the livability of a home. But in the opinion of many there's little to be said in favor of picture windows facing the front, which you so frequently see in today's mass-produced homes.

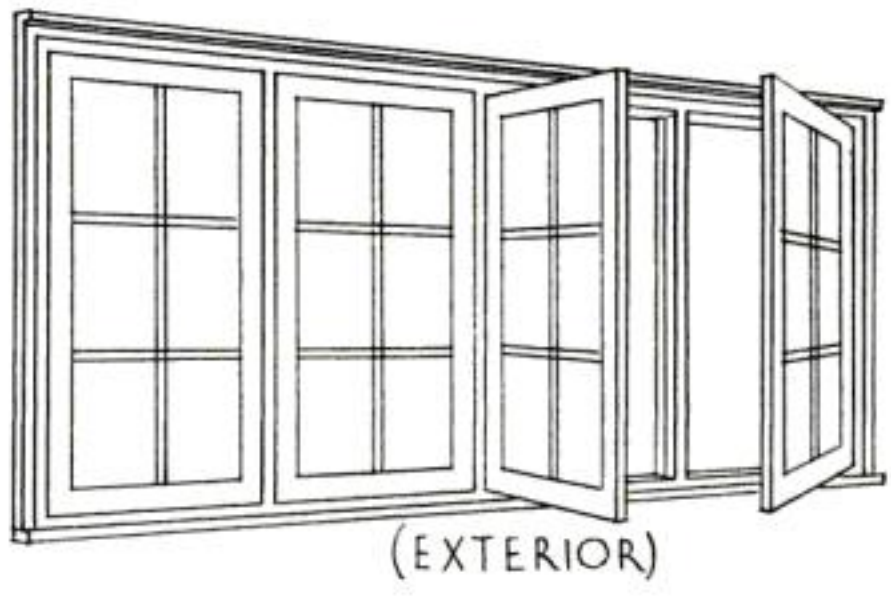
There'll always be a place in good house design for traditional double-hung windows and their more modern companions, windows that slide back and forth horizontally. We discussed these last month.

But you should also think about the types shown on these pages—the casements, the awnings, the hoppers, the increasingly popular bow bays, as well as the stationary windows that form a window wall or picture window. All have come into wider use in recent years, and all have advantages you should know about.

As you'll see, the hinged types can be used to advantage in conjunction with fixed sash to provide good ventilation. Casement, awning, and hopper windows give ventilation in the full open area. In contrast, a double-hung window gives ventilation in only half of its area.

CASEMENT WINDOWS





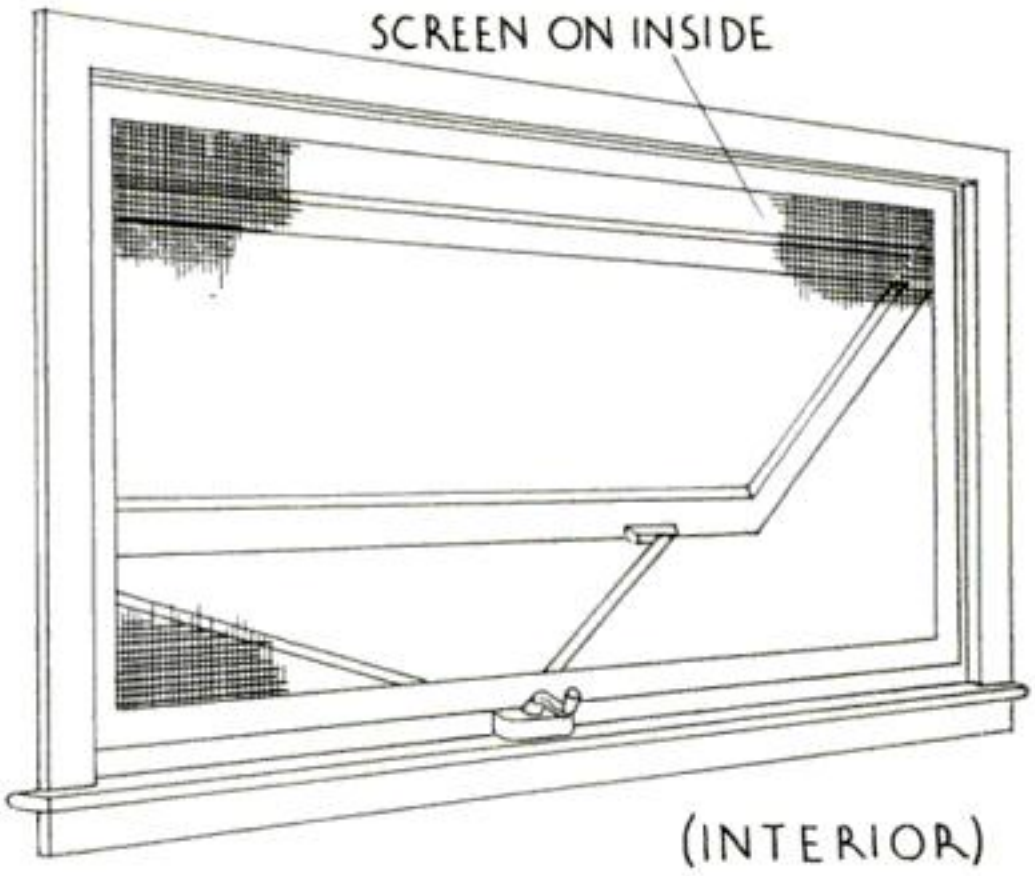
Casement windows are suitable above a kitchen counter or sink because the simple rotary handle makes them easy to open or close. They're just the right size—3′ and three panes high.

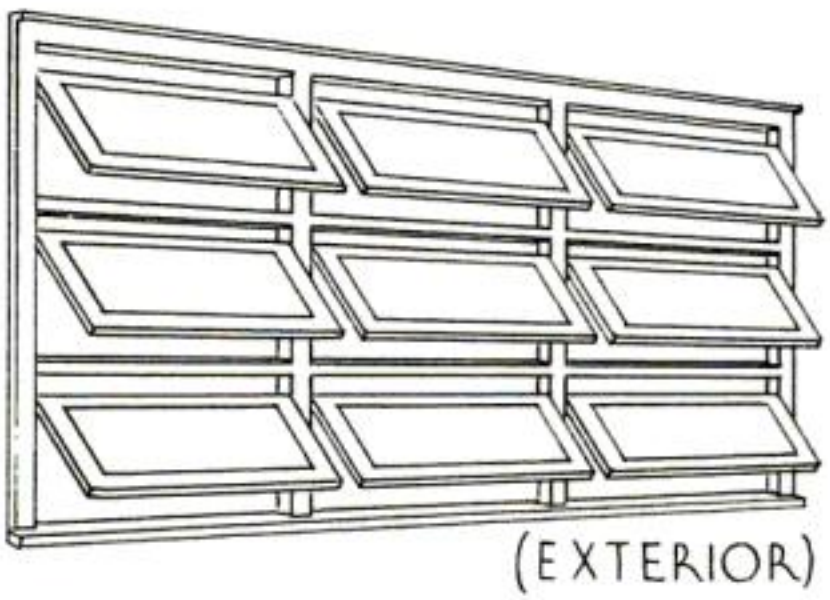
Hinged on the side to swing out, casement windows occupy no interior space. The screens, which must be on the interior, can be the usual rectangular but easily removable type, or roll screens that work like window shades. Improved hardware, positioned below the screen, insures smooth operation when you want to open or close the windows. Stock sash are available with two-sheet insulating glass, or with single glass and optional storm sash or panels in thin metal frames. Spring-tension-type weatherstripping makes firm contact on all four sides when the sash is locked in the closed position. Mullions (vertical divisions between adjacent sash) are a slim 1¾" or 2¾" wide unless thay are load bearing, in which case they enclose a stud and are 5¼" wide.

Urheberrechtlich geschütztes Material

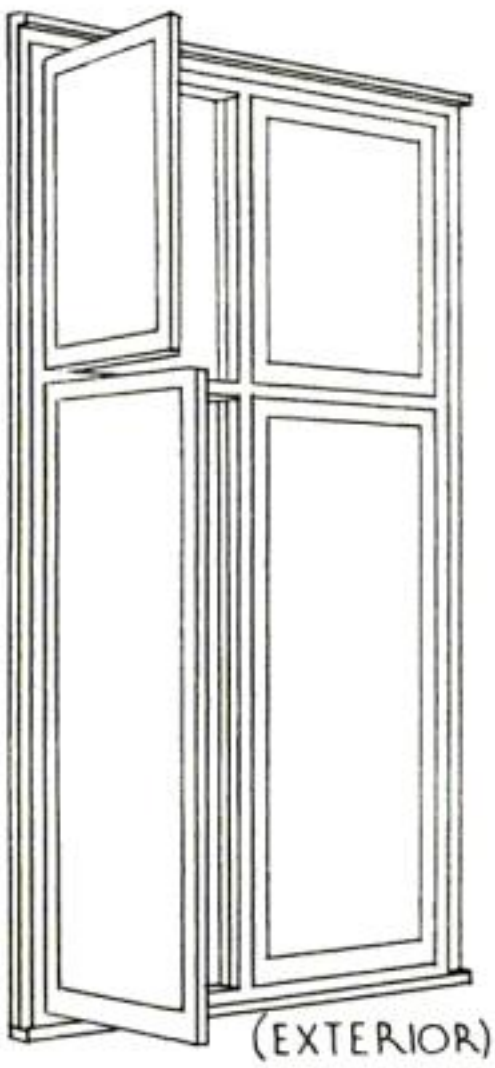
AWNING WINDOWS

A triple-purpose window (right) has been developed and is now widely used. The same unit can be hinged at the side to swing out as a casement, hinged at the top to swing out as an awning type, hinged at the bottom to swing in as a hopper sash. Awning windows are available with weatherstripping, and with removable storm panels attached to the face of the window. Three styles of snap-in, snap-out muntins (horizontal, regular, and diamond) are furnished in a variety of sizes. There are three types of operating devices: rotary gear with handle, extension bars, and locking handle.




(EXTERIOR)

Awning windows (left) have found ready acceptance in contemporary design. For a large window area, it is seldom necessary to use more than three units vertically and three horizontally because nine units can provide a window area 12′ 4″ wide by 9′ high. One advantage of awning windows: Very little (if any) rain can enter when sash is left partially open and an unexpected storm occurs when no one is home.


(EXTERIOR)

A series of casement windows (left), stacked vertically in pairs, will give vertical emphasis better than any other type when large glass areas are wanted in rooms with ceilings over 8′. For good proportions at maximum height, use the combination at left—a pair of 3′-high sash above a transom bar and a 6′-high pair below.

Snap-in, snap-out muntins are available in three designs and in a variety of sizes. This recent development has become popular because (1) for the first time insulating glass can be used with a small-pane effect, and (2) the former chore of painting or washing small panes of glass has been eliminated. The new muntins are made either of wood or of white plastic.

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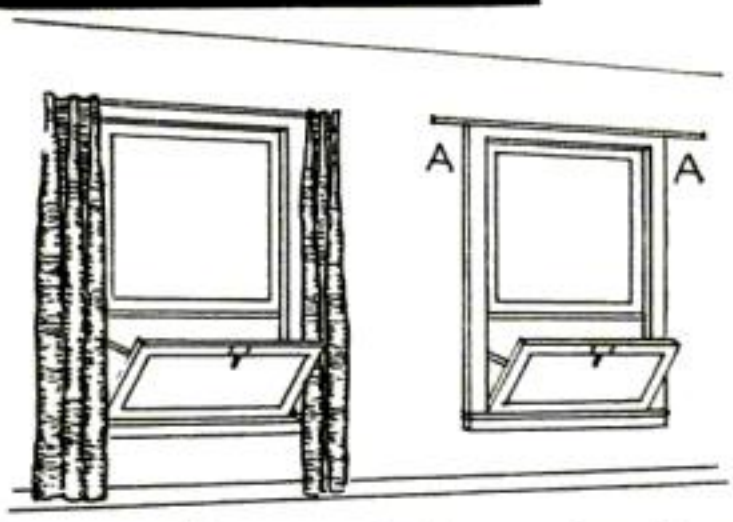
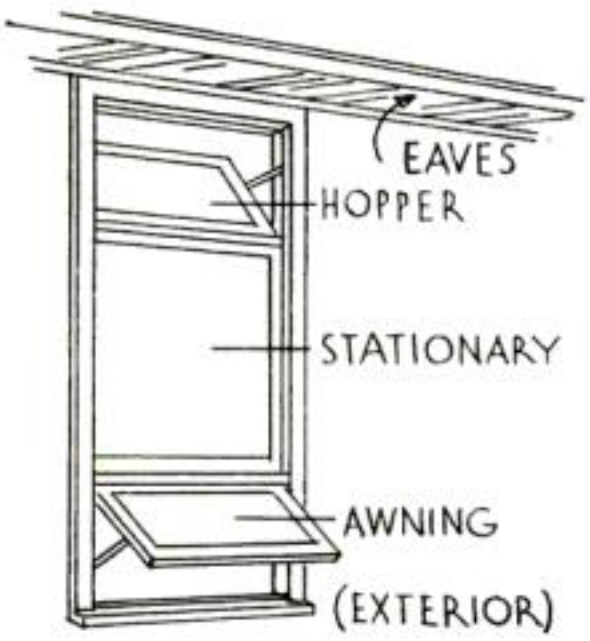
Urheberrechtlich geschütztes Material

HOPPER WINDOWS

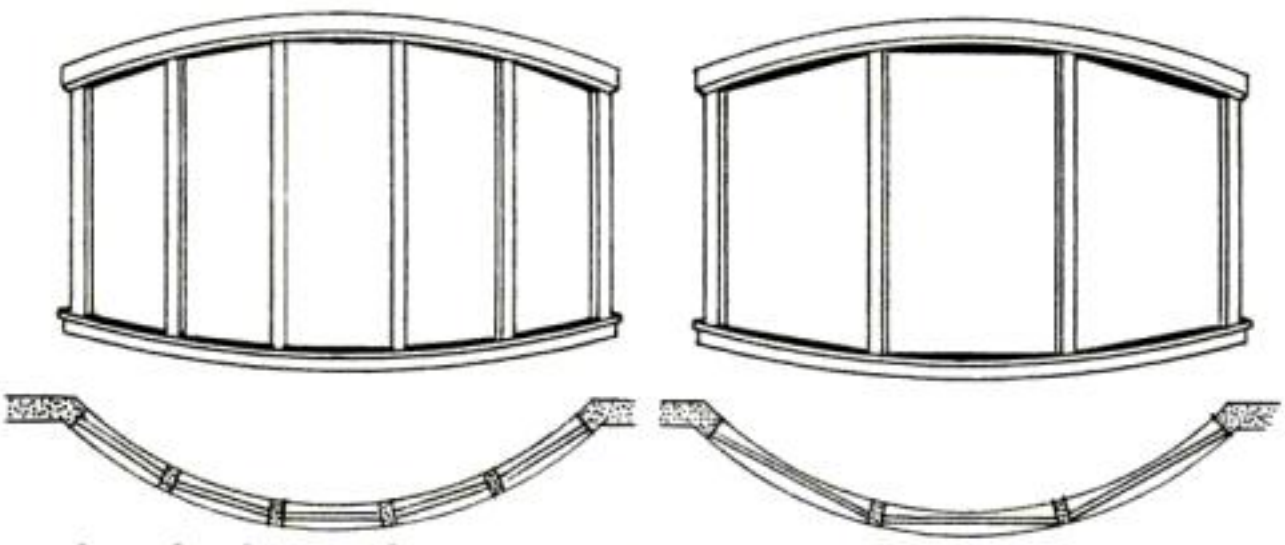




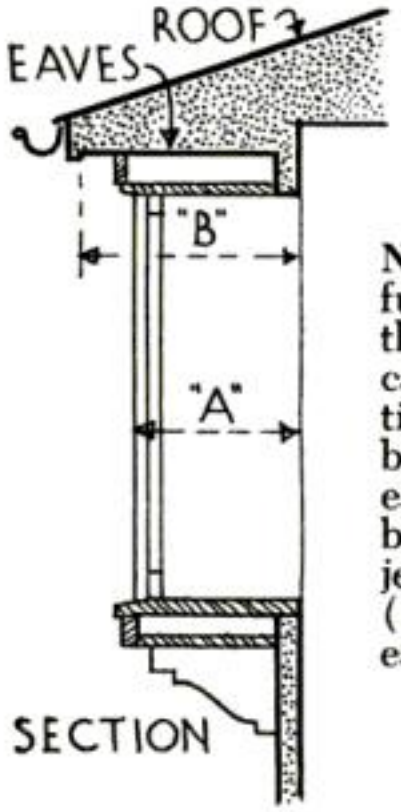
Because a hopper window swings inward, it will interfere with curtains not pushed back the full window width. This problem is solved if the curtain rod projects beyond the outside edges of the casing (A-A in sketch) as at far left. Stock hopper windows are available with weatherstripping, removable screens and storm panels, and optional snap-in, snap-out muntins. There are two types of locking devices: (1) a handle that pivots and secures the window, and (2) a snap-spring lock with a ring for high window units that require a window pole.

A stationary sash is often used with an awning window below and a hopper above. The fixed sash gives you an uninterrupted view. The hopper window at the top, with overhanging eaves to prevent rain from coming in, will increase natural air circulation by inducing air movement along the ceiling. An awning window near the floor, used with an in-swinging hopper sash at the top, helps control indoor air currents by deflecting incoming air toward the floor. This combination is especially useful in a room with only one exposure.

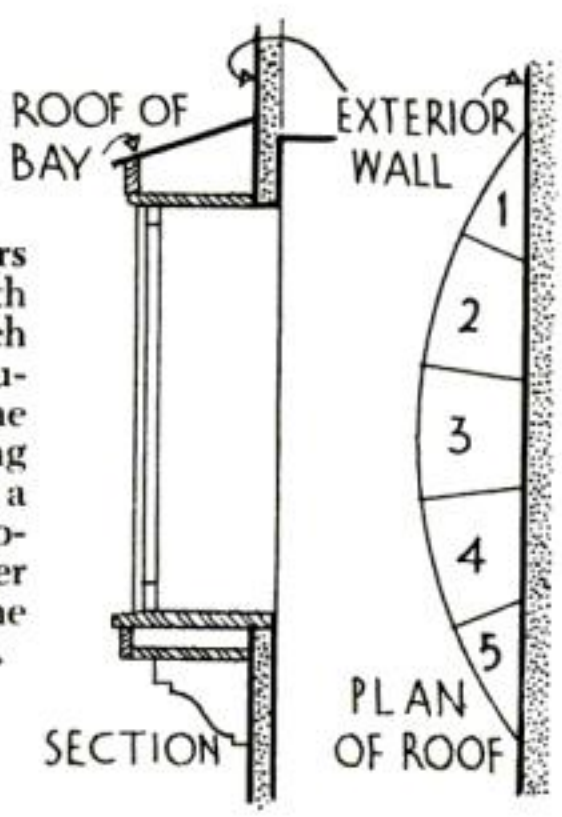
BOW BAY WINDOWS



A stock bow bay has a curved top and sill, but the individual windows are usually stock flat units. Some makers furnish only a segmented (not curved) top and sill, which correspond with the flat units. The narrower the units are, such as casements, the more successful the effect in creating the illusion of a bow. Conversely, when wide individual units are used, the few large flat segments destroy the illusion of a continuous curve. If wide units must be used, it is preferable to build a three-sided bay, with the end sash at 45 or 60 degrees to the face of the house.



Not all manufacturers furnish a roof with their bays, in which case the simplest solution is to locate the bay under projecting eaves, and to select a bay whose greatest projection at the center (A), is less than the eaves projection (B).



A bow bay on a gable end will require its own roof, because you find no horizontal eaves. A few stock bow bays are available with shaped wood segments and wedge blocks to form the rough boards for the roof. However, a carpenter can do the framing for stock bays without roofs. The owner must provide flashing and roofing material.

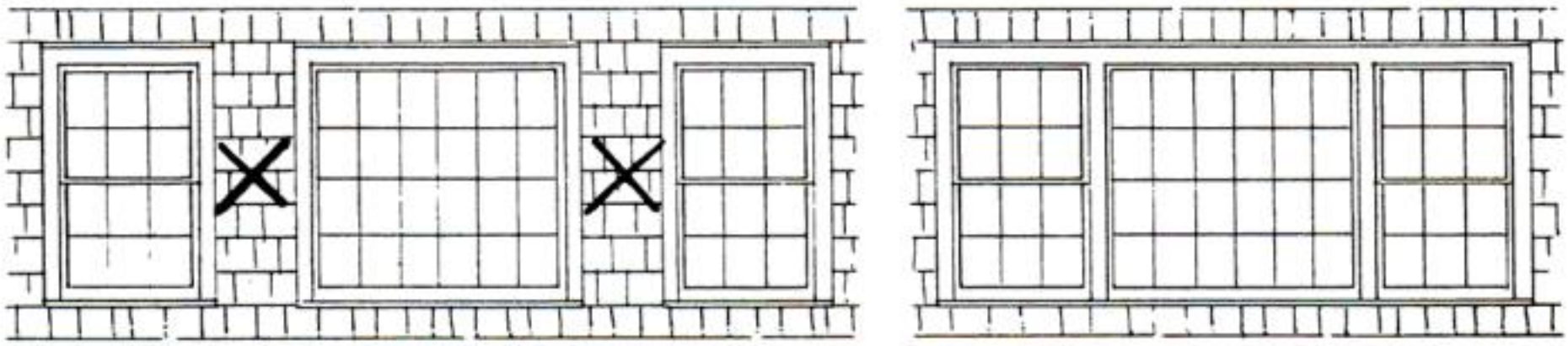
Urheberrechtlich geschütztes Material

STATIONARY WINDOWS

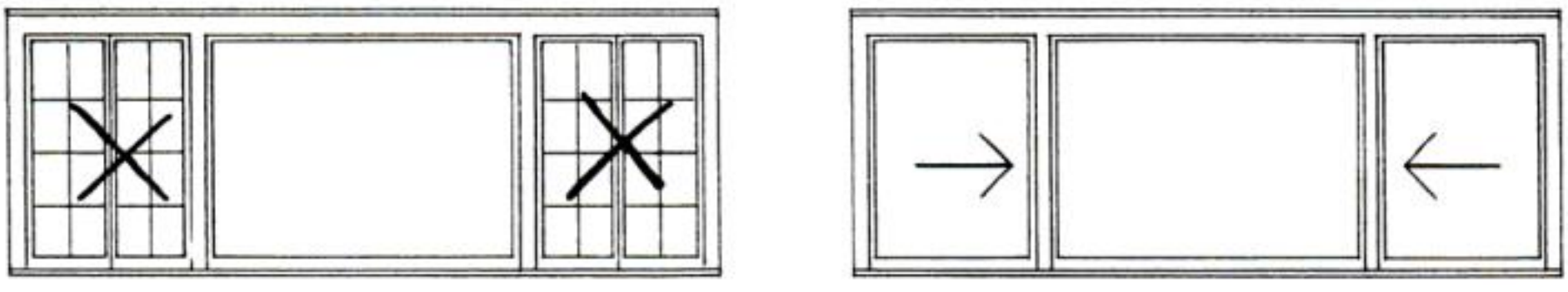
STATIONARY windows fulfill the primary function of windows. They permit the cheerful illumination of an interior. But they also favor your looking out—and that's one of their greatest appeals, especially when you have an outdoor view worth looking at.

Large fixed windows need insulating glass—two panes of glass hermetically sealed into the sash with an air space between. This eliminates the need for storm windows and can mean a substantial saving in heating and air-conditioning costs. To be comfortable in summer, you can prevent the buildup of solar heat by opening the windows on either side of the fixed sash.

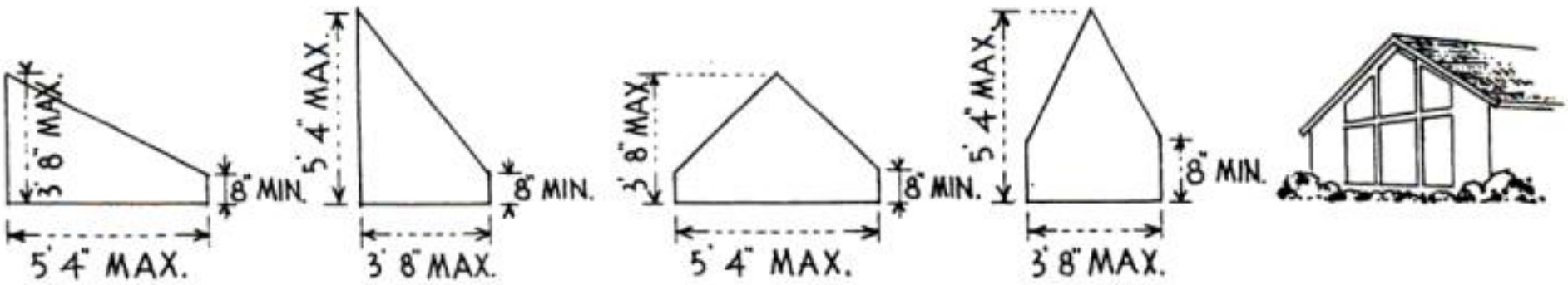
These sketches show some of the architectural rules on use of fixed windows.



For a unified look, lower costs, and to make it easier to arrange furniture, a stationary window should have one operating window adjacent at each end (above, right) rather than solid-wall intervals between the three sash (left). A variety of stock insulating-glass window sizes, as well as permanent or snap-in muntins, are available for harmony in pane size between operating and stationary windows. When traditional small panes are used in a house, it's preferable, from a design viewpoint, also to use them in a large picture window.



"**Flankers**" is the term some manufacturers use for the operating sash on one or both sides of a stationary window, and in their catalogues they often show only one divided into small panes (above, left). If there is a good view outdoors, it makes sense to use a pair of sliding or casement sash without muntins on each side of the stationary sash (right). It's illogical to divide a pleasant outdoor view into small segments only at the left and right ends of the picture window. There is available a triple combination consisting of a fixed central unit and left and right sliding units, both of which slide behind the large stationary window.

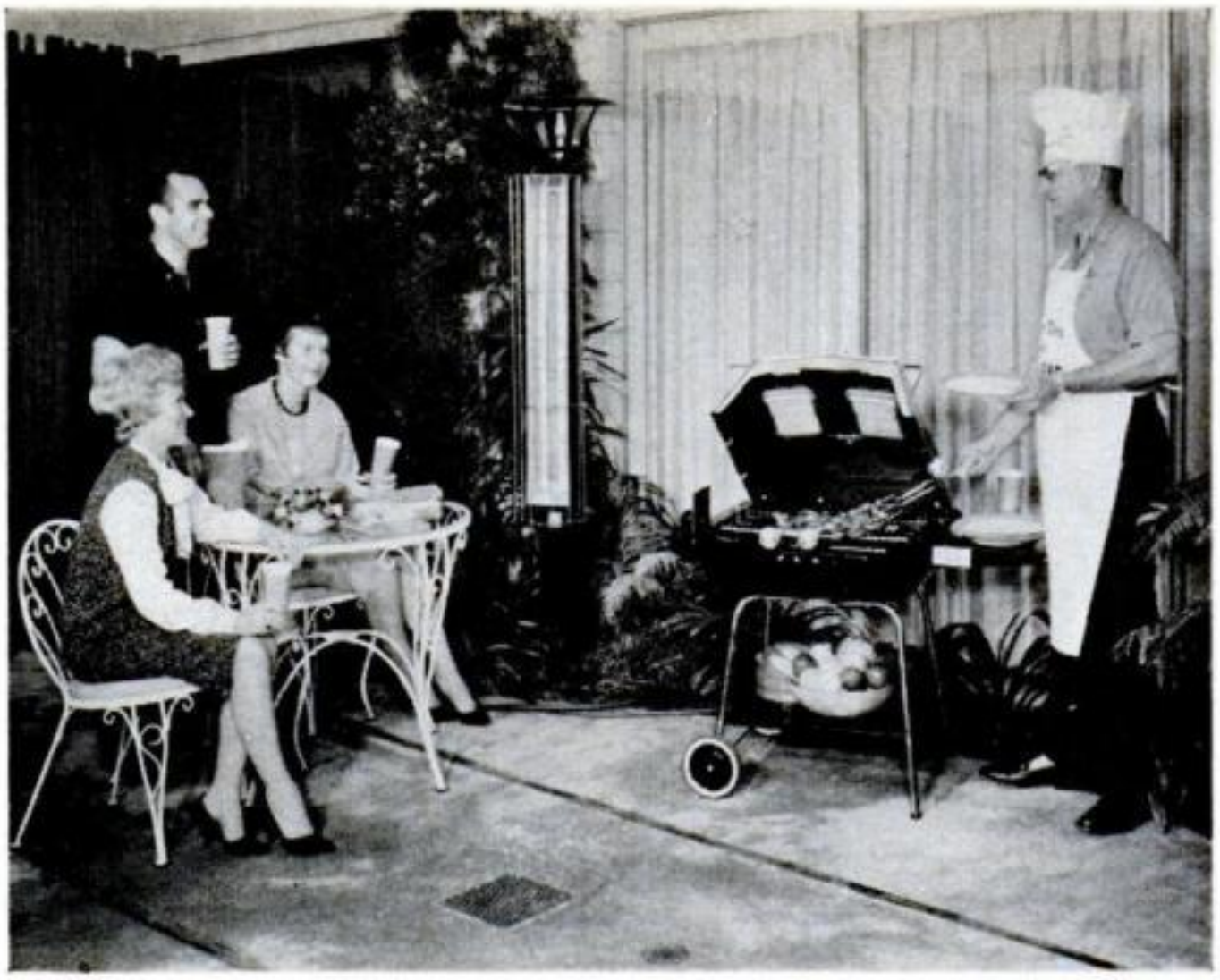


Trapezoidal-shaped stationary windows, factory made, are now available for use in gable ends. A variety of sizes and shapes are offered, as shown in the sketches above. Trapezoidal storm-sash panels can be furnished on order, and would be preferable to a long delay in ordering special insulating glass. Instead of imbedding the glass in wood sash members for irregular shapes, an alternative method is to use the wood structural members as though these were the actual windows, and cut the glass to fit in the desired openings. The glass can be held by moldings on both sides or moldings inside and points-and-putty outside. ■ ■

Urheberrechtlich geschütztes Material

PS HOME IMPROVEMENT

Now— Cook with Gas in the Back Yard



BARBECUE with gas? Sure thing. And while you're at it, you can light up and warm the patio, too. There are two gas infrared burners in the hood of this heavy metal barbecue oven. You fire it from the household gas line, making the connection with a rubber hose. Nut and flange connectors on the hose ends fit tightly over a permanent gas cock installed in the back yard and over the oven intake cock. There

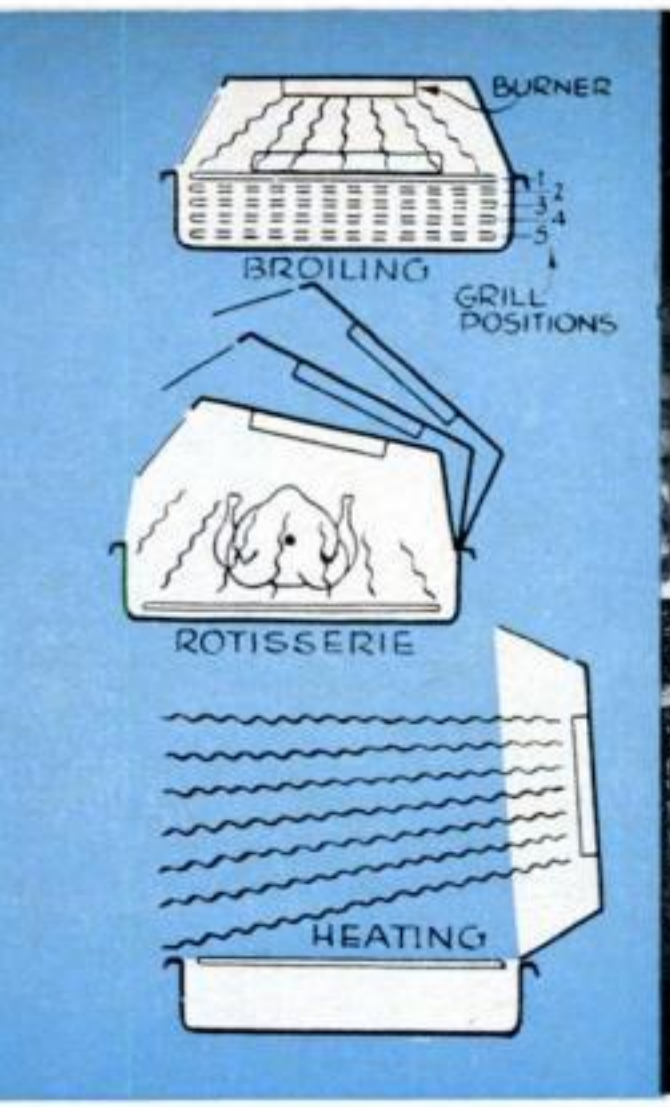
No hands—this door closes itself

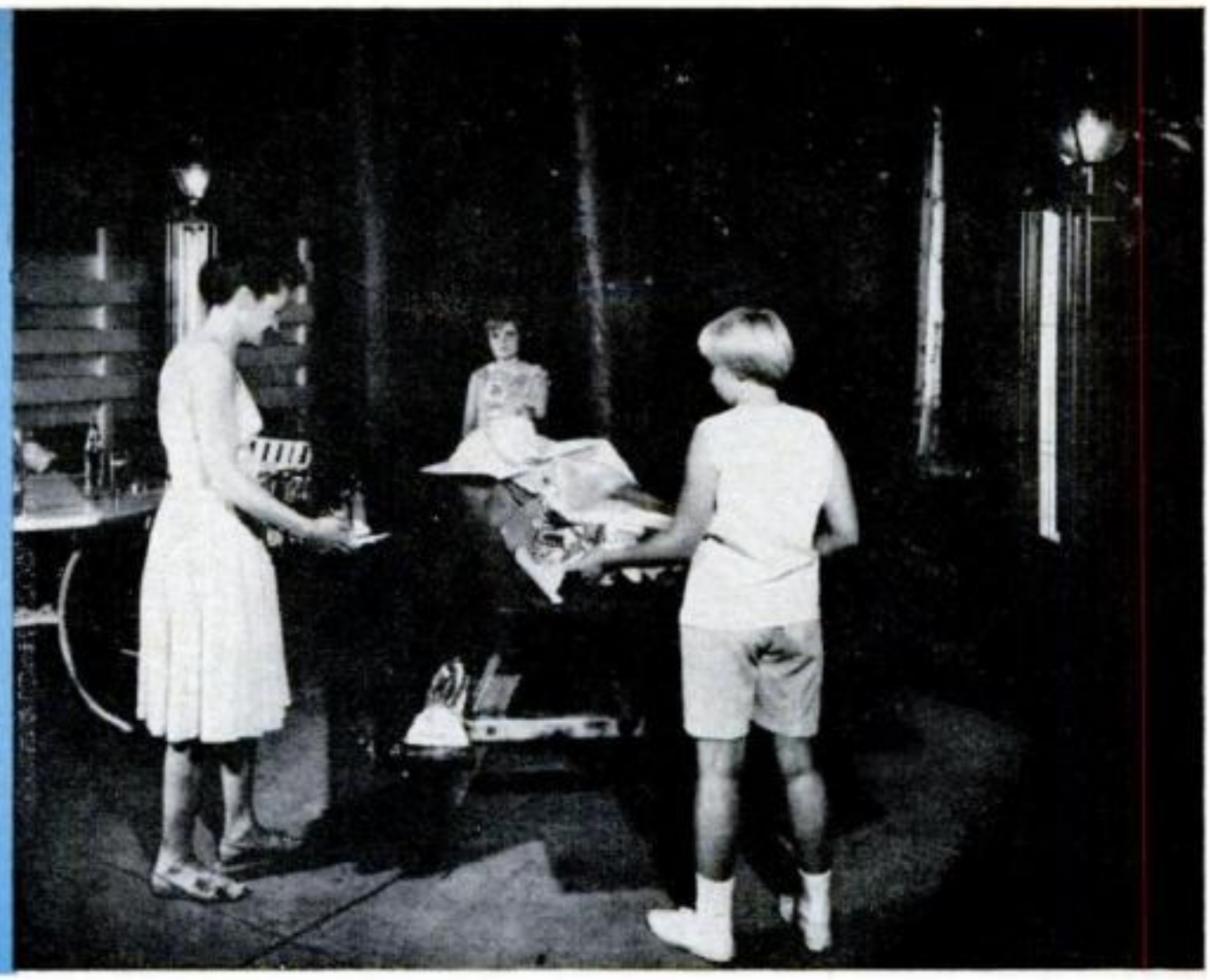
If a storm door can close on its own, why can't a sliding glass door? It can, if you install the long-armed piece of hardware shown at left; air pressure takes over. There's a similar model for a sliding screen door. McGraw Manufacturing Co., 1489 South Broadway, Denver.

Exit with a glow—any time you choose

Making signs that glow at night needs only a stencil and a press of this aerosol-bomb button. Other uses: marking a walkway, lighting up a house number, marking a path through brush or woods. Sprayon Products, Inc., 26300 Fargo Ave., Bedford Heights, Ohio.

Urheberrechtlich geschütztes Material





are five grill positions for broiling, and three hood positions for roasting meat on the electrically operated rotisserie. Raise the oven to a vertical position and you have an effective space heater. Cost is about $170.

The same company (Hupp Infra-Red, 1135 Ivanhoe Rd., Cleveland) also produces lamp-post-mounted radiant heaters (above) for outdoors. These also operate on gas, cost between $150 and $170 per heater.

Permanent shade now comes in a package

It will take about one afternoon to erect this canopy over your patio. Canvas, cord, galvanized posts, frame, and hardware are prefitted and packaged in a kit. The awning material is duck in green, red, yellow, turquoise—some colors solid, some with white stripes. For a 10-foot-square area, the kit would cost $110; without valance, $85. Jensen-Lewis Co., 156 Seventh Ave., NYC.

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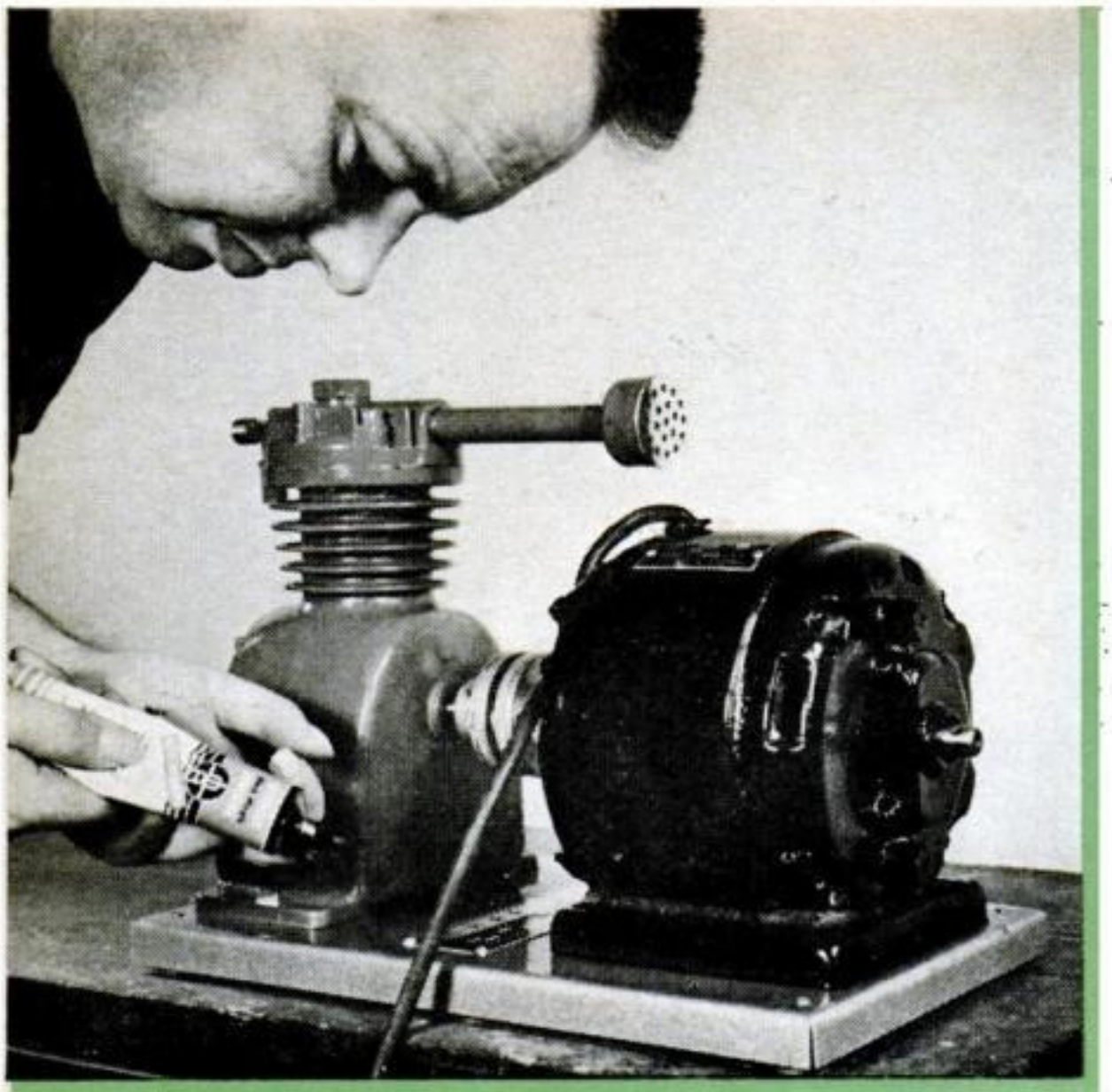
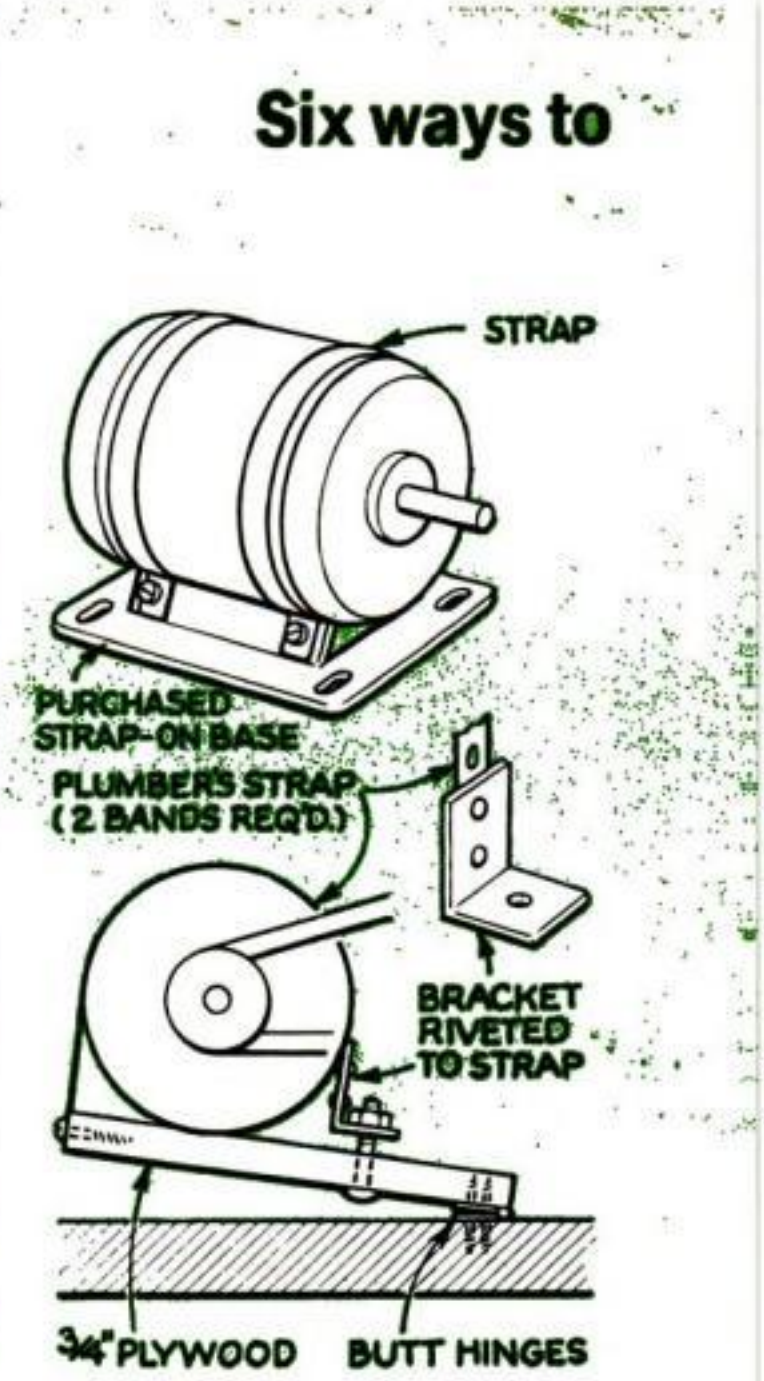


Salvaged from an oil burner, the motor driving this little compressor had no base. Its housing was sanded clean, then **cemented to a wood block, which was chiseled concave to fit it. A black rubber-based mastic was used as cement.**



MOTOR MOUNTS That

Here's how to get more use out of any motor—and salvage some motors you thought were useless

By Harry Walton

PS SHOP TECHNIQUE

COULD be there's a better way to install that motor than just bolting it down. The right motor mount can deliver more power, keep fuses from blowing, maintain belt tension automatically, or make one motor do double or triple duty.

Hard up for motor money? There are scads of good motors to be salvaged from discarded washing machines, dryers, oil burners, and refrigerators. All it takes to put them to work in your home shop is the right mount.

You can rig mounts that let undersize motors shoulder full-size loads—or make two small ones pull in tandem to do the work of a bigger one.

In setting up power tools, or in shifting a motor from one to the other, it's often necessary to change the direction of rotation. An easy non-electric way to do this is to turn the motor around bodily.

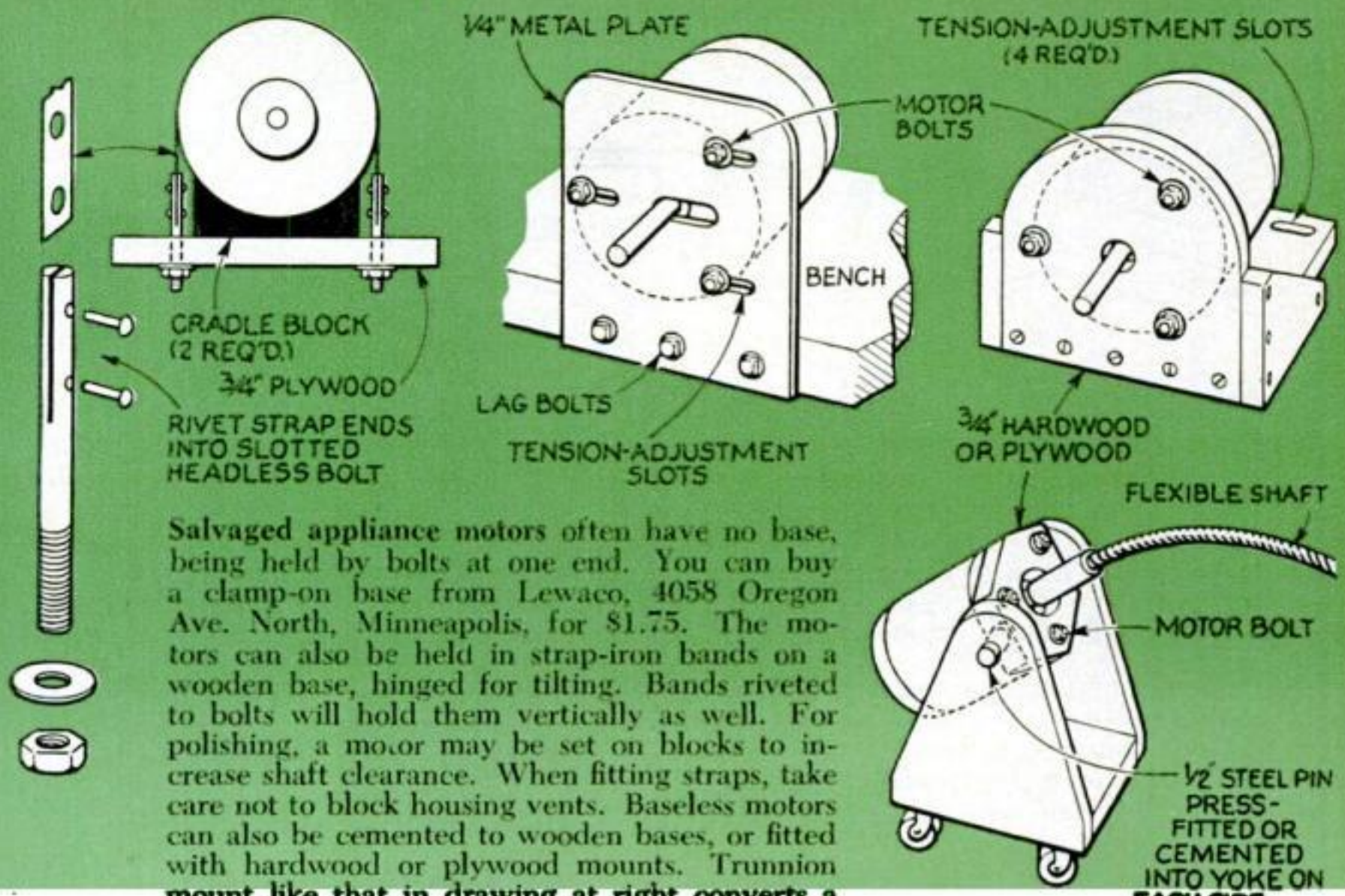
Sometimes this offsets the motor the wrong way, where it interferes with other equipment or overhangs its support. If the shaft is double-ended, a second pulley on the other end may solve the problem.

If it doesn't, electrical reversing may be necessary. On some motors a nameplate diagram shows how. If in doubt, better have it done by an expert.

You can team up two motors of the same speed rating to do the job of a bigger one.

Urheberrechtlich geschütztes Material

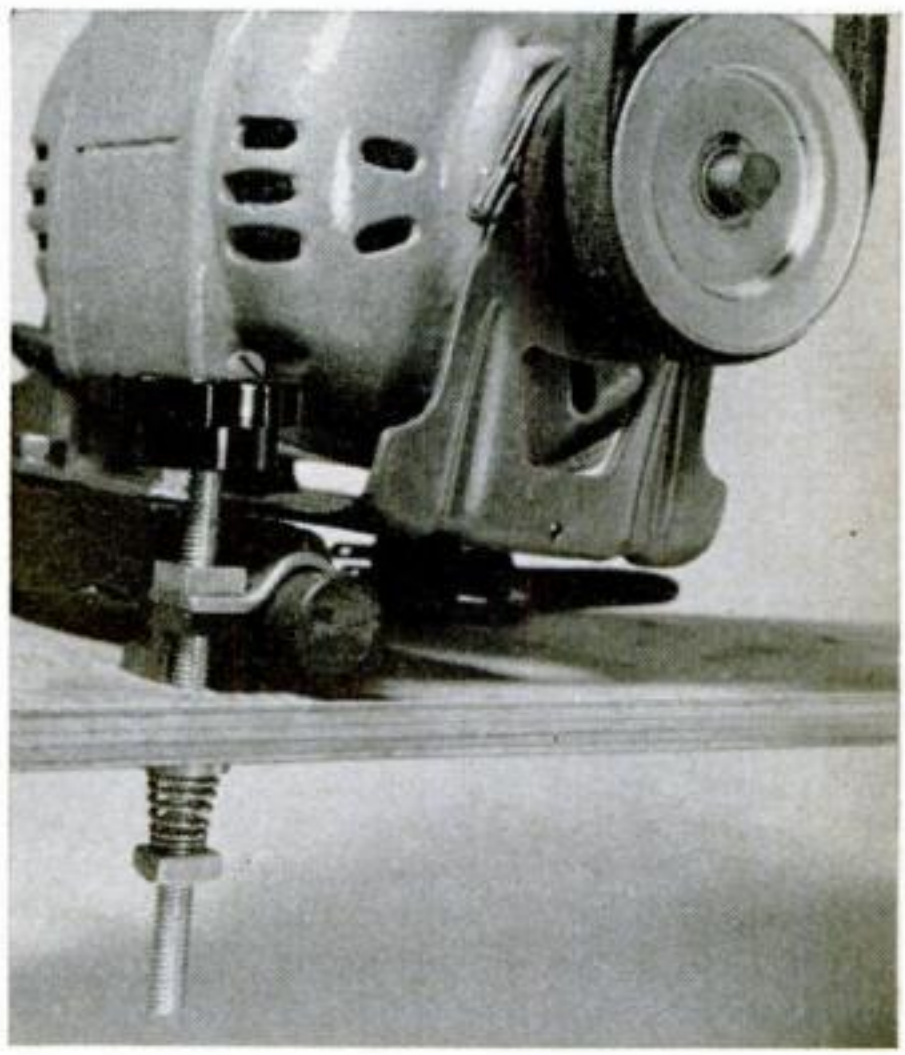
mount baseless appliance motors



Salvaged appliance motors often have no base, being held by bolts at one end. You can buy a clamp-on base from Lewaco, 4058 Oregon Ave. North, Minneapolis, for $1.75. The motors can also be held in strap-iron bands on a wooden base, hinged for tilting. Bands riveted to bolts will hold them vertically as well. For polishing, a motor may be set on blocks to increase shaft clearance. When fitting straps, take care not to block housing vents. Baseless motors can also be cemented to wooden bases, or fitted with hardwood or plywood mounts. Trunnion **mount like that in drawing at right converts a motor into a portable flexible-shaft tool.**

Solve Shop Problems

If either has a double-ended shaft, mount it so that it runs the same way as the other. Join the shafts with a flexible coupling, putting the drive pulley on the outer shaft end. If both motors have single-end shafts, there may be room for the pulley alongside the coupling. Otherwise, use a two-belt drive with identical pulleys. You may have to reverse one motor electrically.



To drive a machine above it, a motor on a floating rail must be held down. Here a ⅛"-thick plate curved to fit is held on a threaded rod by two nuts. Another nut and a spring under the supporting shelf pull the rail down, putting the belt under tension. At the other end, it is hooked under a fixed clip. To release the motor, the knob on the rod is pulled up. The base holding this ⅓-hp. washer motor cost $2.50 from Complete Reading Co., 612 North Clinton Ave., Chicago. Similar mounts are available for other baseless motors.

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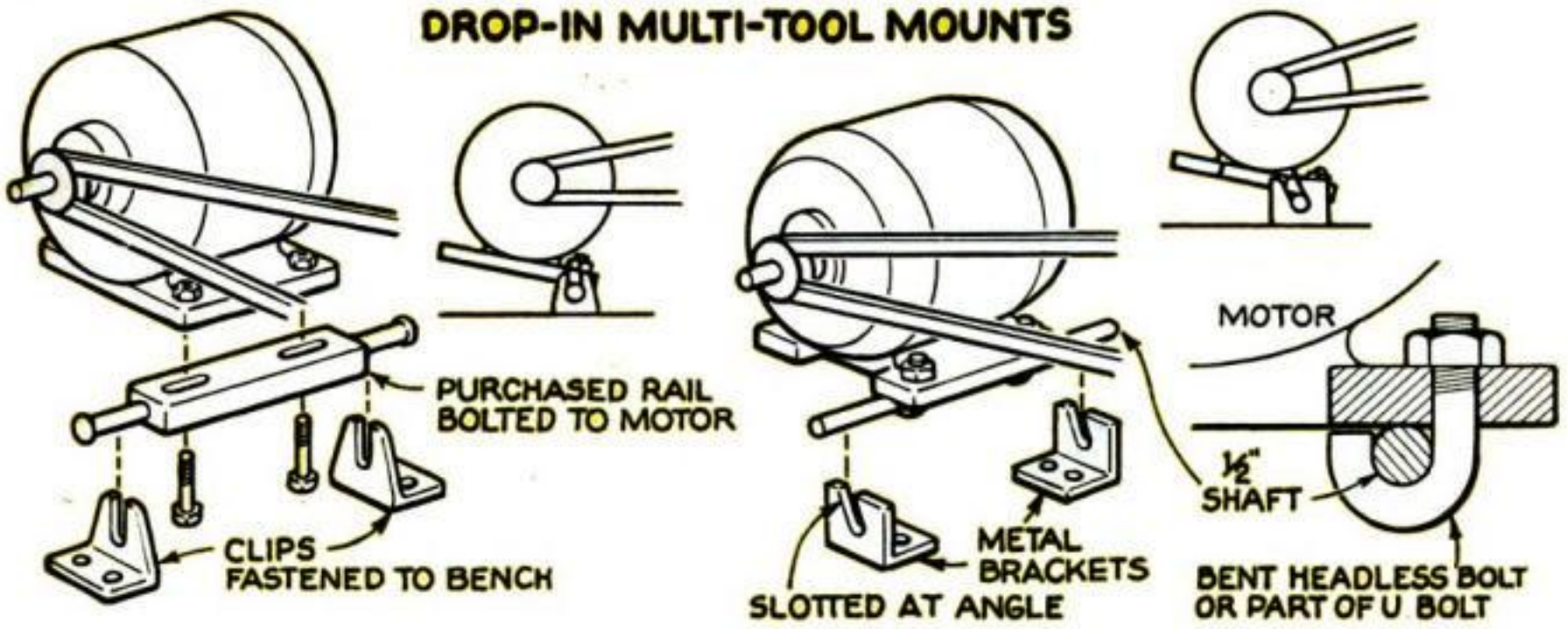
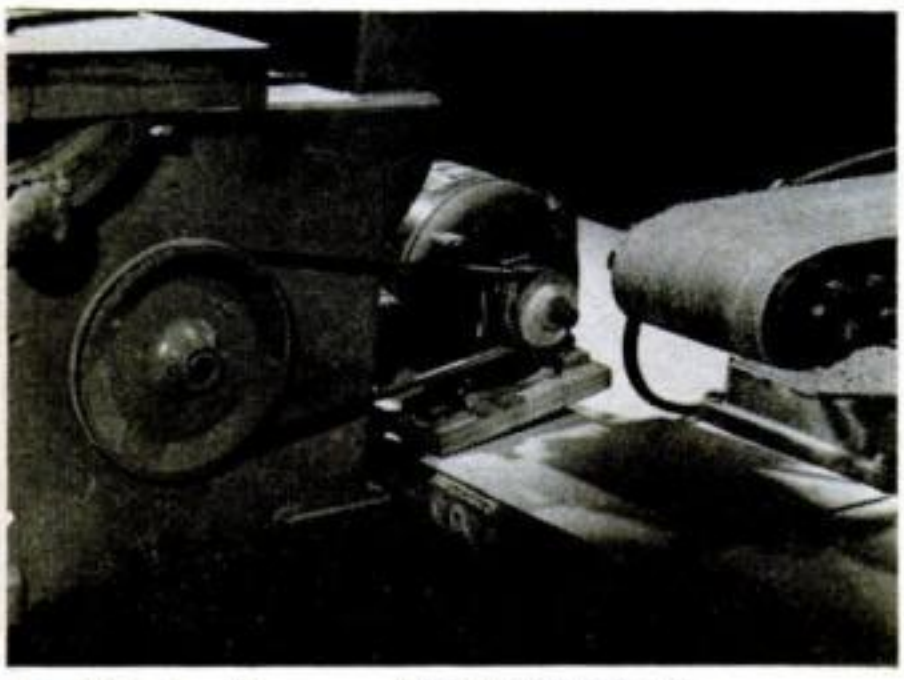
Urheberrechtlich geschütztes Material

One detachable motor can drive



Switch one motor from tool to tool for top economy. It's easy with a drop-in mount. The floating motor rail above comes with bench brackets, ready to attach. You can buy it for $1.19, plus shipping charges, from Sears, Roebuck, and install extra brackets (50 cents) at each machine you want to power. The homemade drop-in mount has angled slots that keep the motor from jumping out at starts. For horizontal drives, the pivot point of such tilting mounts must lie between the pulleys. Belts must be short enough to tilt the motor well up; if it hangs nearly flat, it may put excessive strains on the belt and bearings and cause rapid wear.

When power tools can be ganged on a bench, the motor may slide from one to the other on a long rail as shown. Several belts



One motor drives either of these two power tools. The weight of the motor on its hinged mount (a piece of plywood on butt hinges) keeps the belt to the bandsaw at driving tension. To run the sander, the belt is switched over and a wedge is pushed under the mount to tighten the belt, as shown in the drawing.

Good motor mounts provide for belt tensioning

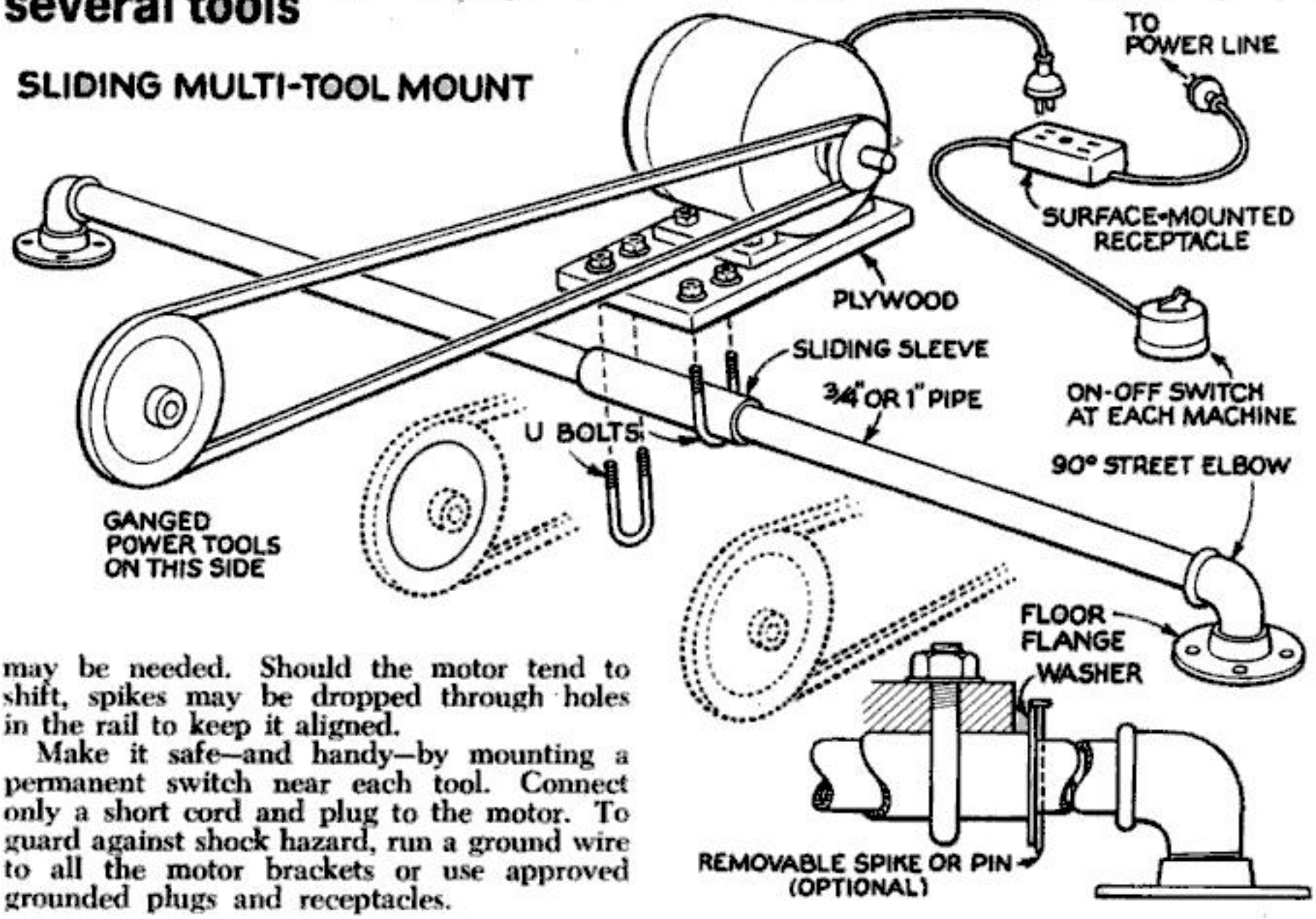
Any new belt eventually stretches, so your mount must prepare for this, as shown in drawings at right. If the motor base is slotted, place bolts to leave room for moving the motor back. If the base has plain holes, drill and file slots in the bench or tool stand to allow for belt take-up. For vertical drives, a motor may be mounted on bolts with nuts above and below it. By adjusting these, the motor can be raised or lowered. Slotted angle, which has short slots all along it, makes a versatile motor mount when bolted across tool-stand rails. In awkward locations, where the motor can't be moved by hand, a bolt turning in a bracket will push it back, putting tension on the belt.

A motor hung under its support on big T hinges will keep the belt taut automatically. Enlarge or drill extra holes in the hinge for motor bolts as needed. Hinges can also be used to mount a motor above the bench. Sturdier tilting mounts are made of angle iron and pipe or shafting as shown in the drawings. To drive downward, add a tensioning bolt at the free end.

Urheberrechtlich geschütztes Material

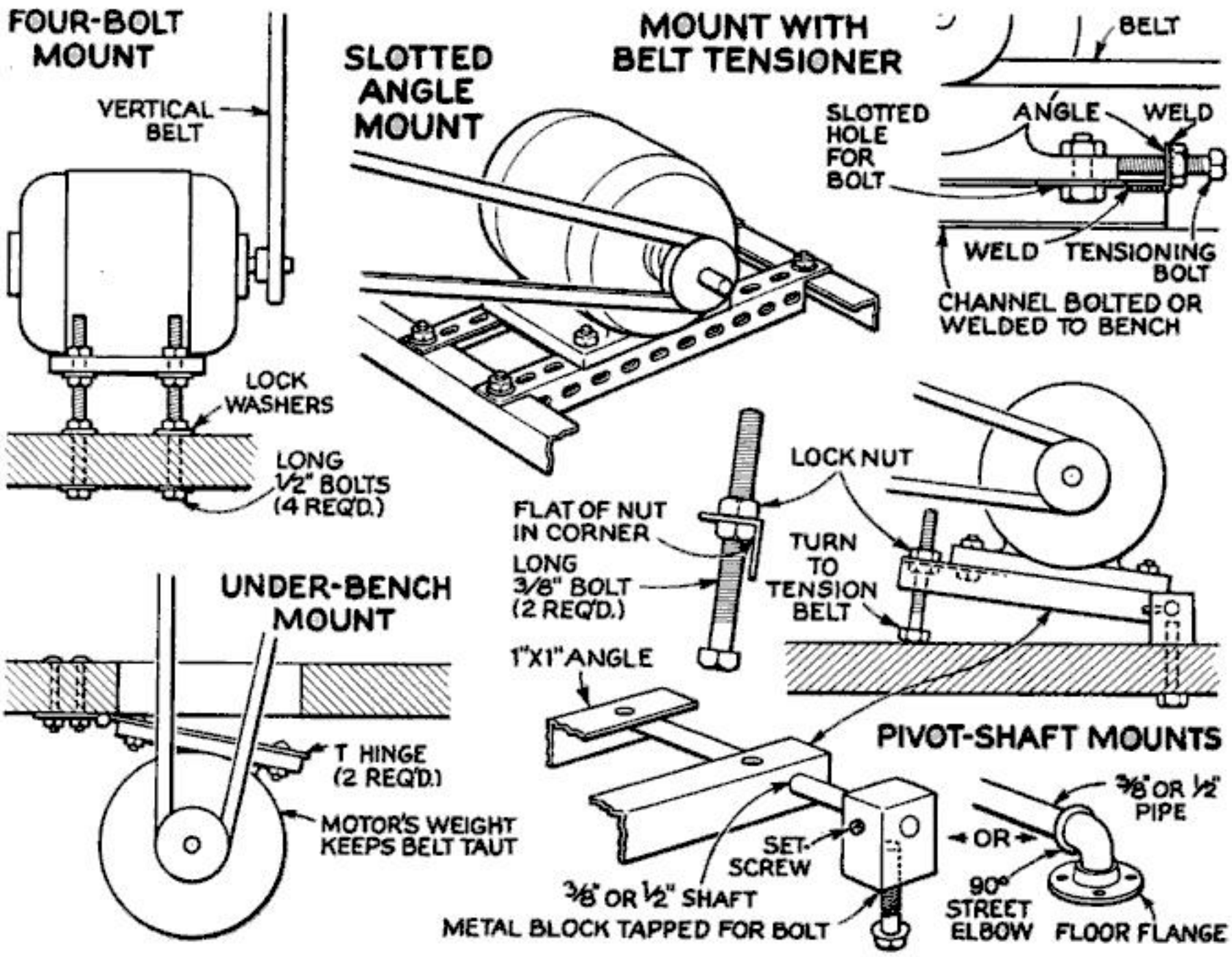
several tools

SLIDING MULTI-TOOL MOUNT



may be needed. Should the motor tend to shift, spikes may be dropped through holes in the rail to keep it aligned.

Make it safe—and handy—by mounting a permanent switch near each tool. Connect only a short cord and plug to the motor. To guard against shock hazard, run a ground wire to all the motor brackets or use approved grounded plugs and receptacles.



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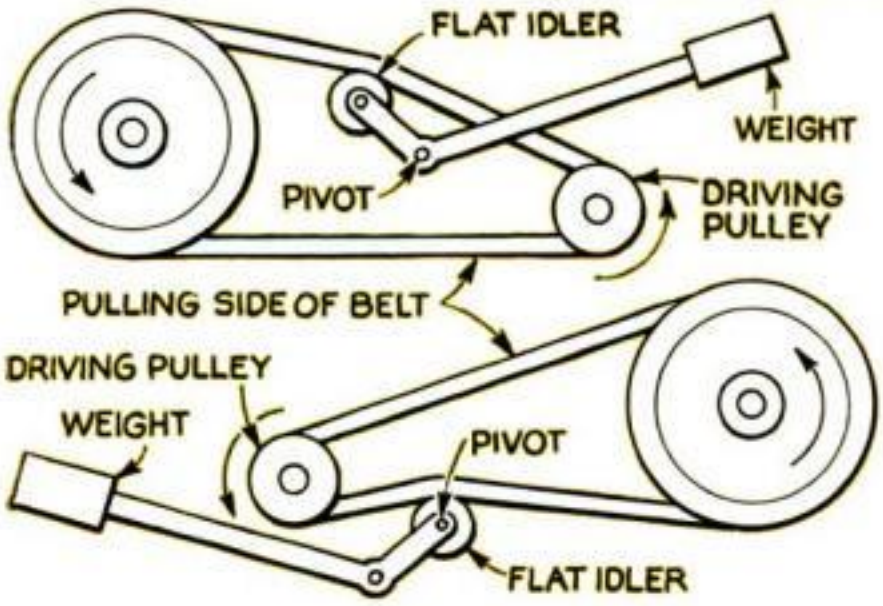
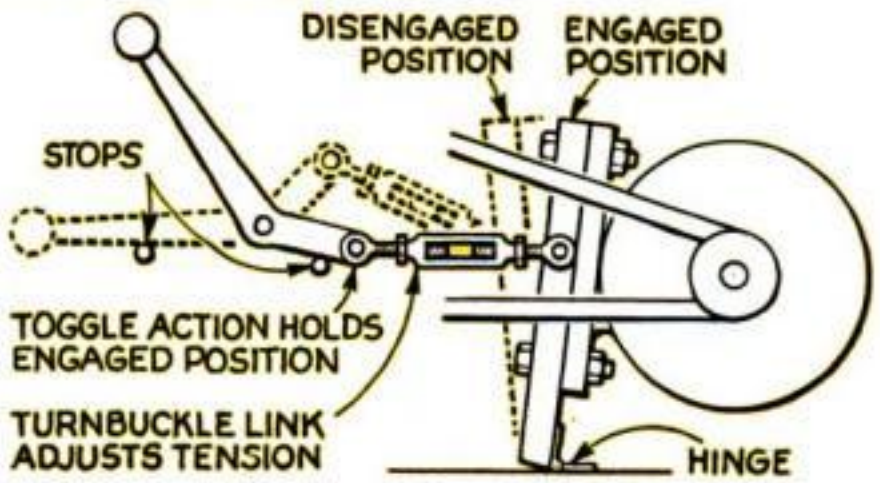
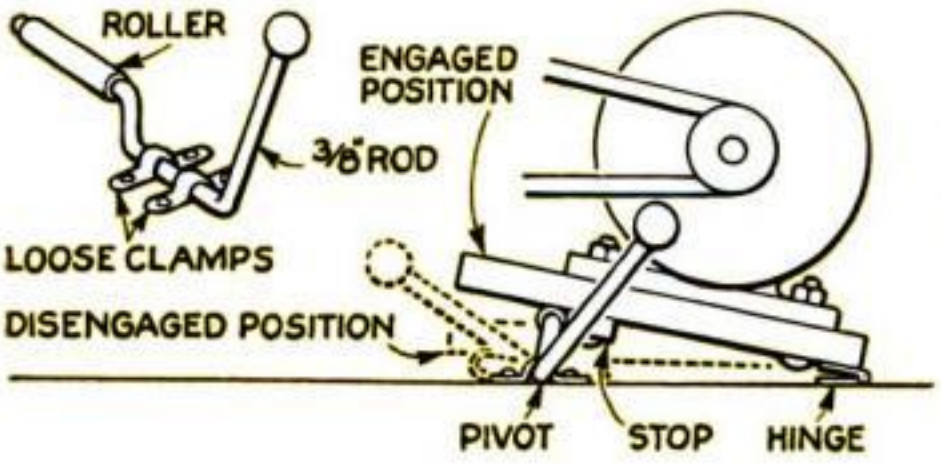
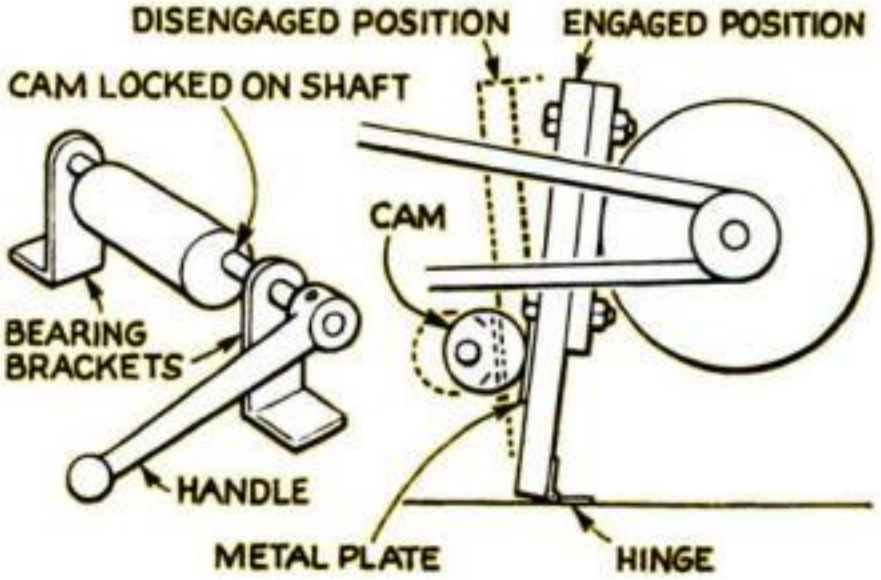
Urheberrecht ch geschütztes Material

Clutches let small motors shoulder big jobs







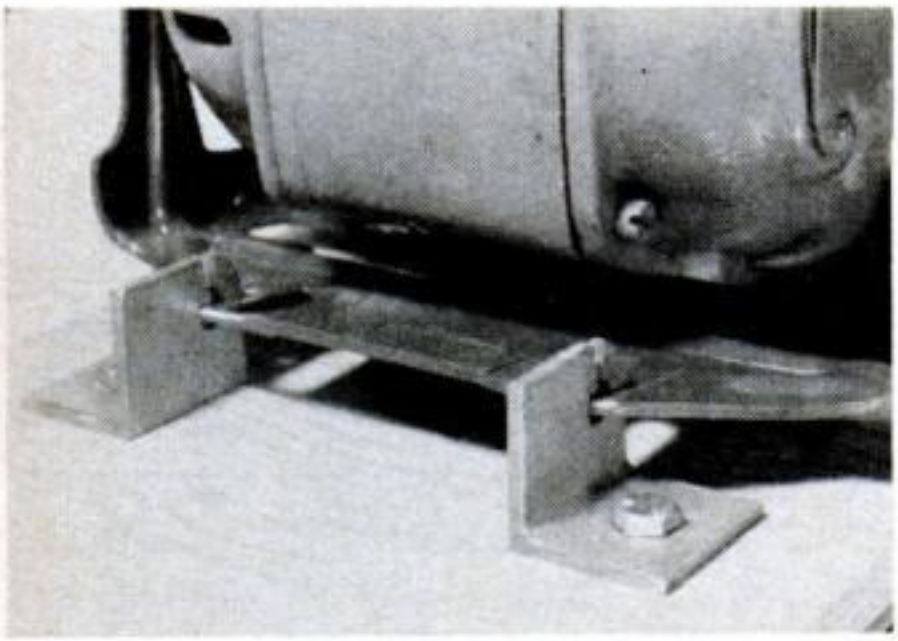


Most AC motors gulp current on starting, especially under load. By uncoupling the load until a motor is over the starting hump, clutches reduce current drain, prevent fuses from blowing, and may allow you to use smaller and cheaper motors.

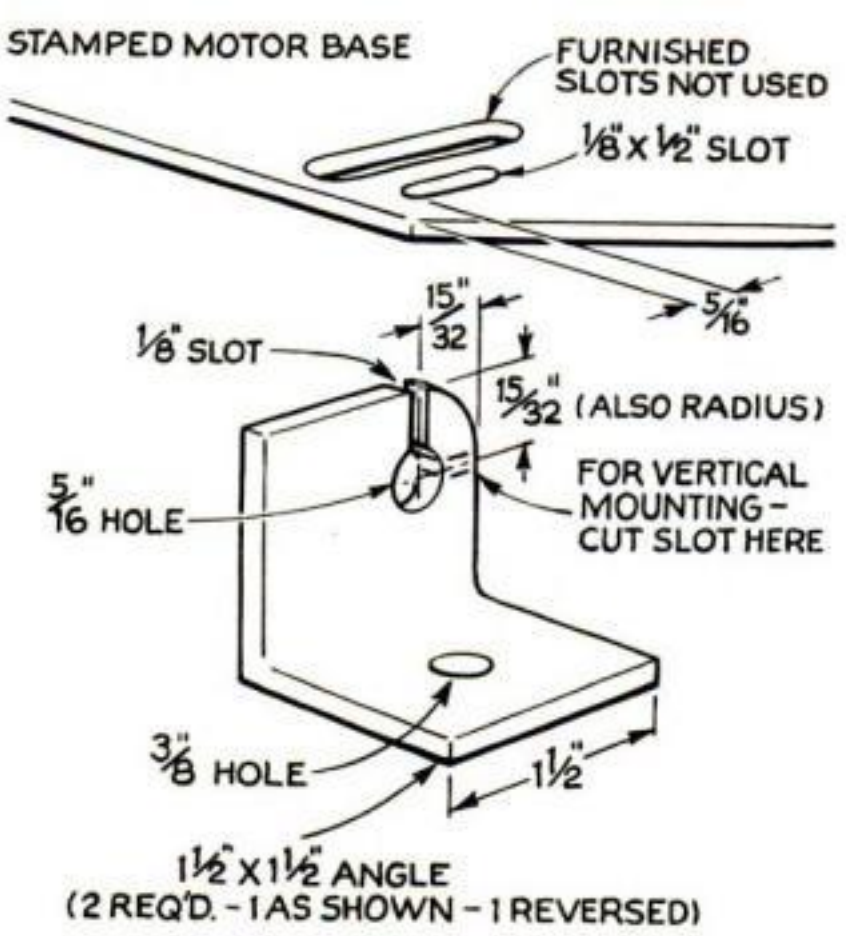
Simplest to install is a centrifugal clutch—simply mount it in place of a plain pulley. Be sure that you get a clutch designed for electric motors; the gas-engine type has a different cut-in point.

A motor on a tilting base can be lifted by hand for starting, then dropped to take up the load. The weighted idler clutches shown are used the same way. Idlers should be at least the size of the small pulley, and should bear on the slack side of the belt. They are best mounted inside the belt, near the large pulley. Idlers on the outside of the belt should be near the smaller pulley, but the reverse bend wears V belts faster.

Better manual clutches can be made by fitting tilting motor mounts with control levers, links (top drawing, above), or cams (lower drawing). With correctly placed stops, they will hold in engaged or disengaged position.



This drop-in mount for motors with stamped bases can hold them in either a horizontal or a vertical position. Once in place, the motor cannot be dislodged by belt pull. Make one bracket right-hand, one left-hand. For motors with cast bases, bolt on ⅛" steel plate slotted like the stamped base shown here. ■ ■



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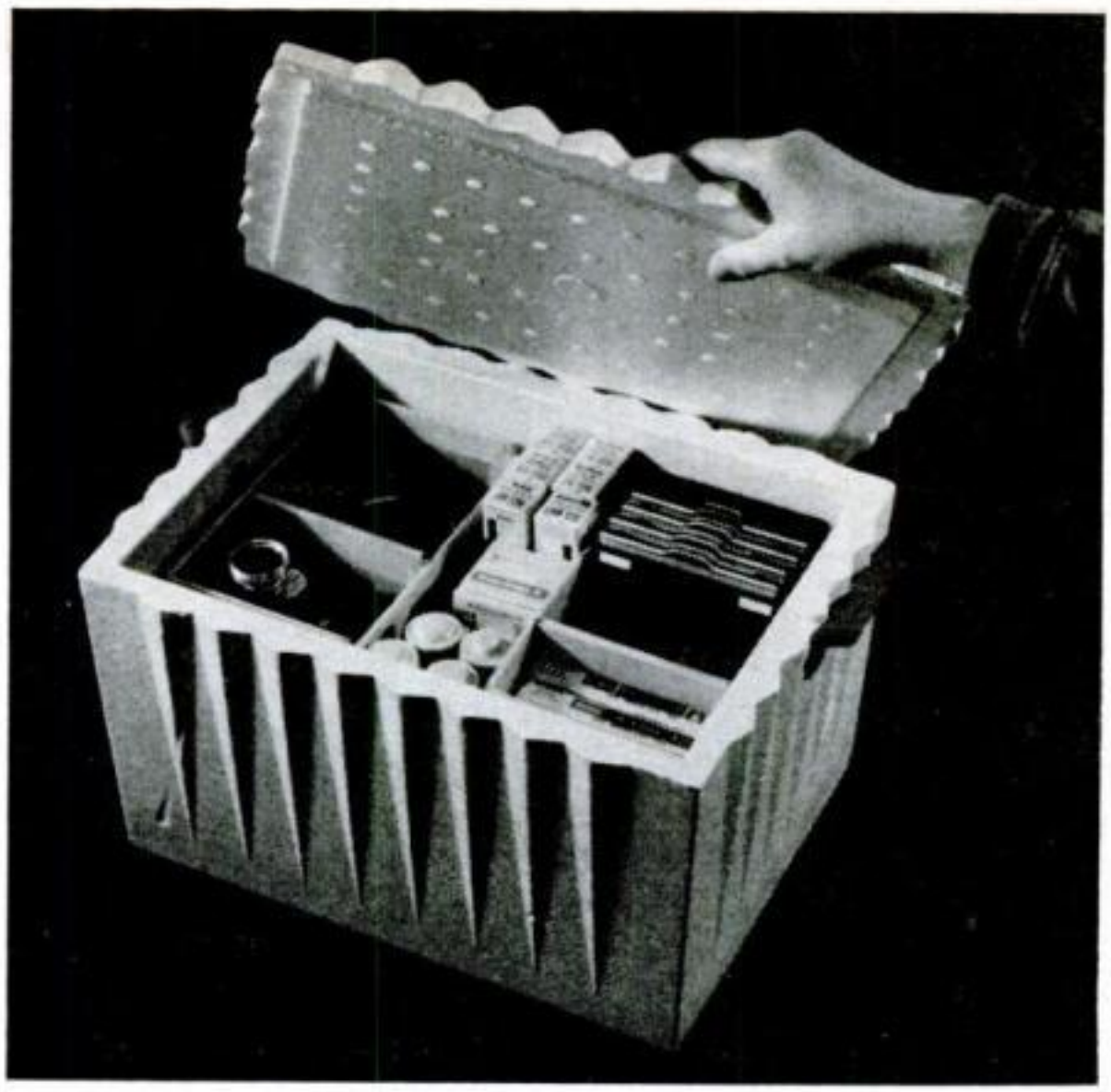
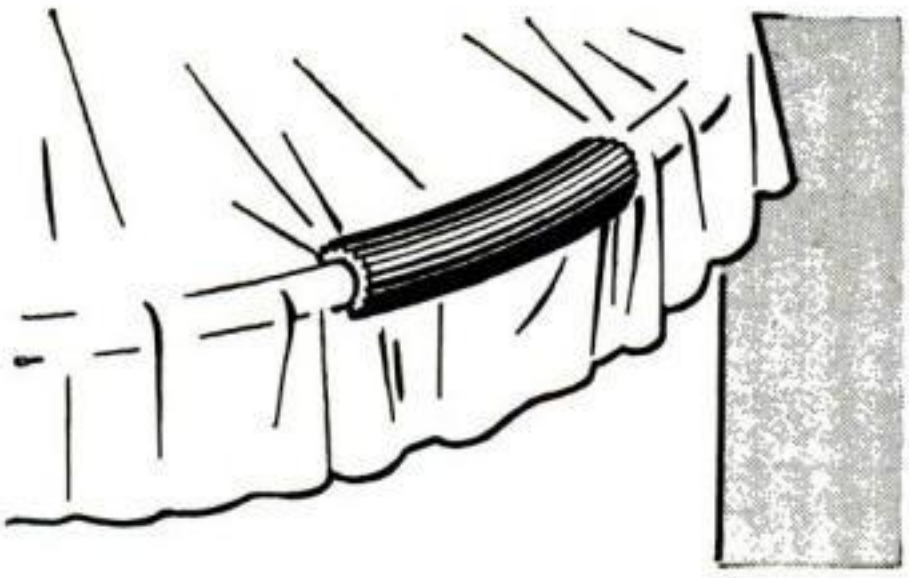


Light, cool, moistureproof camera carrier

The inexpensive foam coolers now on the market make excellent camera and equipment containers for travel and camping. Choose one that best fits your needs and divide it with cardboard partitions. Keep it cool by opening it at night to air it out, closing it during the heat of the day. In very hot weather, place a leakproof bottle filled with ice water or a refreezable ice pack inside.—*R. Schulze, St. Louis.*



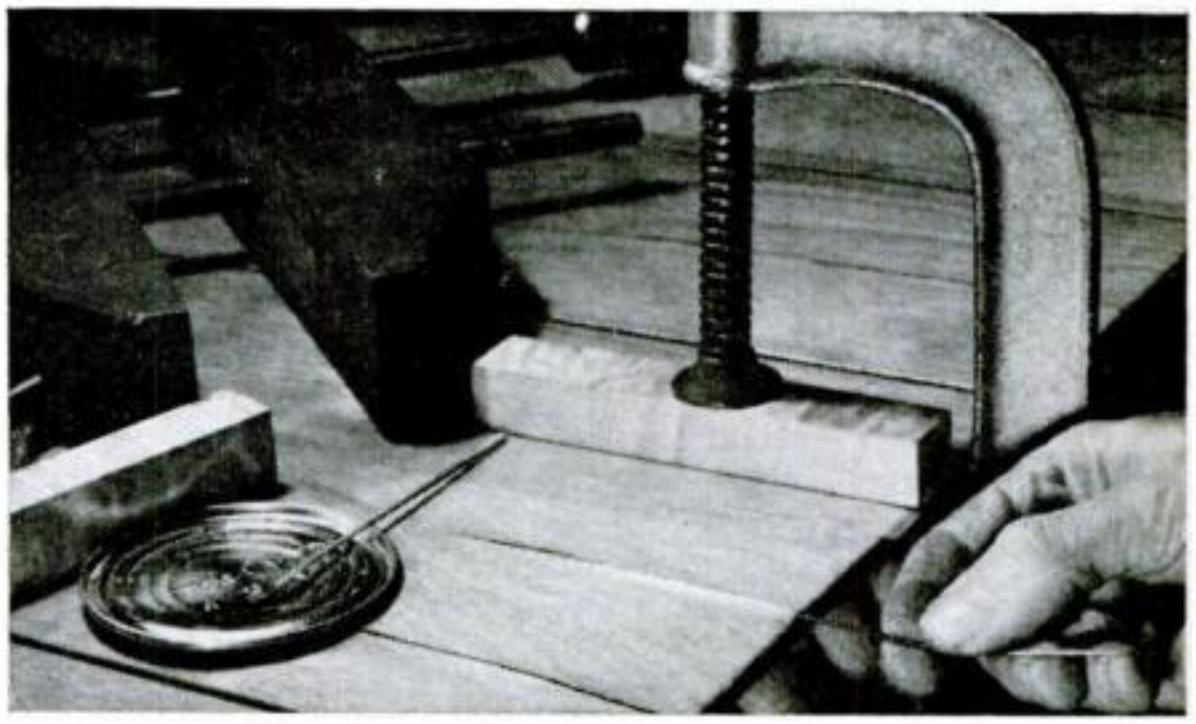
Hose keeps cover on above-ground pool

If you place a plastic cover on an above-ground swimming pool, as some do to keep out debris while it's not in use, here's a trick for keeping the cover from blowing loose on windy days.

Take an old garden hose, cut it into pieces 5″ or 6″ long, slit each one lengthwise, and shove the pieces down over the pool edge. This will clamp the cover in place.—*Sam Megna, Osbornville, N.J.*

How to repair a plywood defect with epoxy

Because it does not depend on evaporation for hardening, an epoxy glue is suitable for repairing cracks and raised areas in plywood veneer when clamping excludes air circulation. In the panel shown in the photo at right, the birch veneer had developed several bad cracks extending inward from the edge. The veneer was loose for ½″ or more on each side.



A thin, flat steel strip was used to work the epoxy cement into the crack and beneath the loosened veneer. A piece of polyethylene film was then laid over the area being repaired, and pressure was applied by means of clamps and wood blocks. After the glue had hardened, the film was stripped off and excess glue on the veneer surface was removed by scraping with a razor blade.—*W. E. Burton, Akron, Ohio.*

Urheberrechtlich geschütztes Material

Sander Stand Swallows Its Own Dust

Here's how you can combine two useful shop tools—a belt-disk sander and a shop vacuum

By John Copeland

THAT sawdust-spouting shop tool—a combination belt and disk sander—can be turned into an immaculate machine with a stand that's fun to build and a pleasure to use.

What does the trick is a shop vacuum tucked inside a sturdy cabinet. Coupled to its business end is an ingenious diverter valve. Flip a handle controlling the valve and you open a passageway, either from the disk or the belt sander, directly into the big canister. Result: The dust is gulped down inside the canister as fast as the whirling abrasives can cut it.

Better yet, the shop vac is not a captive of this one shop machine. It rests on a drawer-like dolly, ready to be wheeled out of its niche and over to other tools any time you wish. And when you shove it back into the sander stand, the vacuum line and power connections automatically recouple. A single toggle switch, located at the rear of the bench, provides simultaneous control of the sander and vacuum-cleaner motors.

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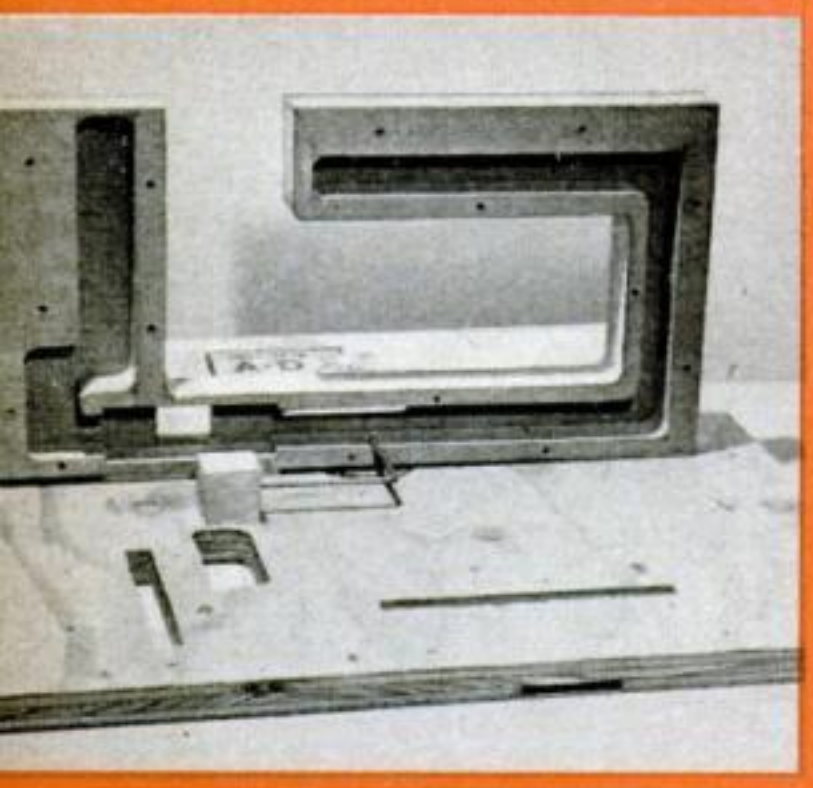
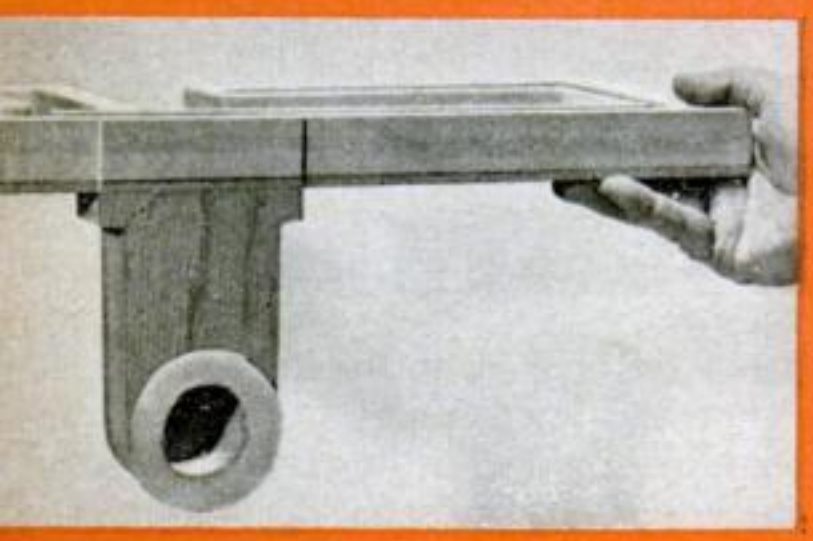
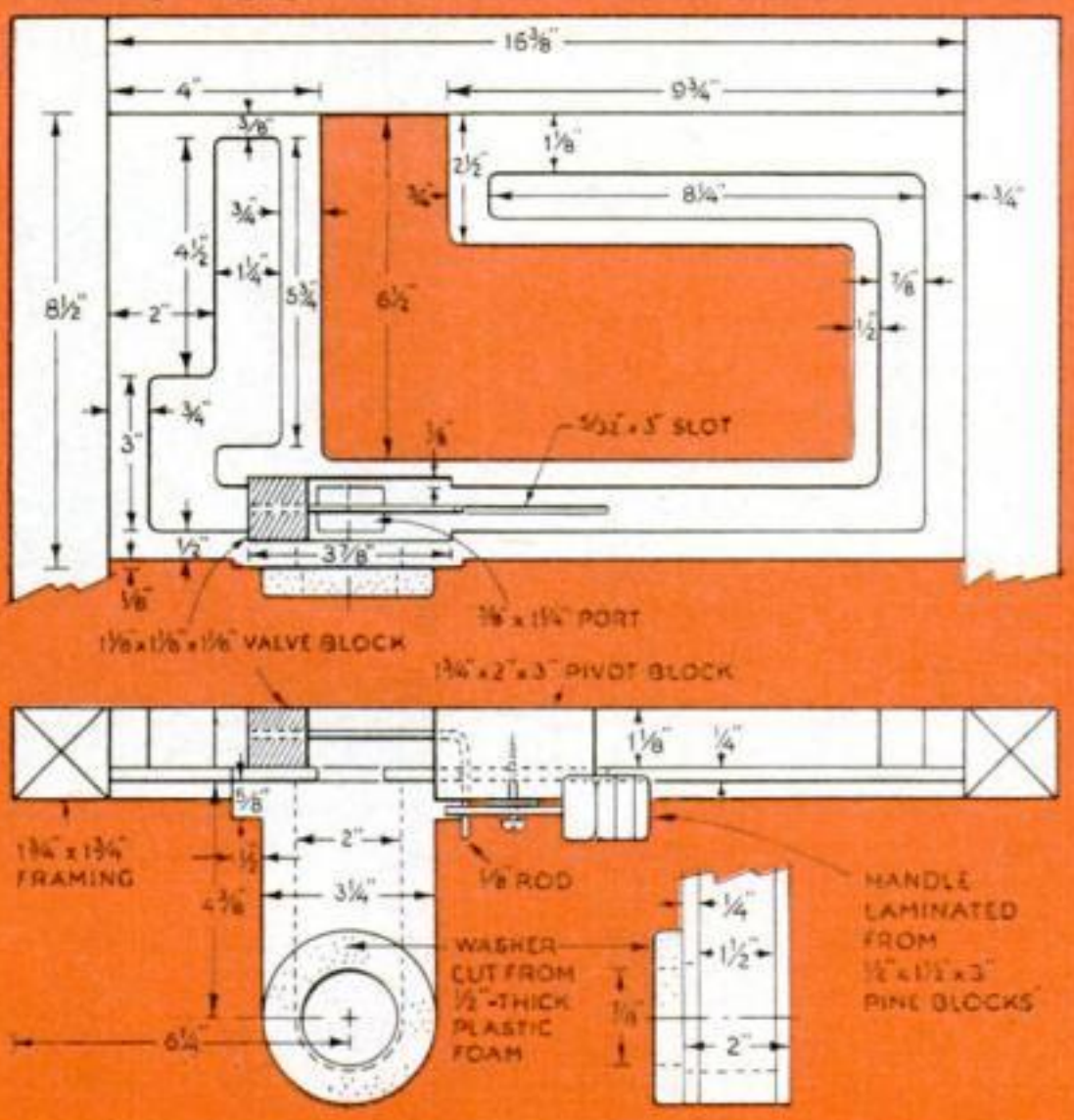




Mounted under the cabinet deck, this diversion-valve assembly directs sawdust from either the disk or belt sander into a hidden shop vacuum. A plastic-foam washer automatically engages the canister's intake nozzle.



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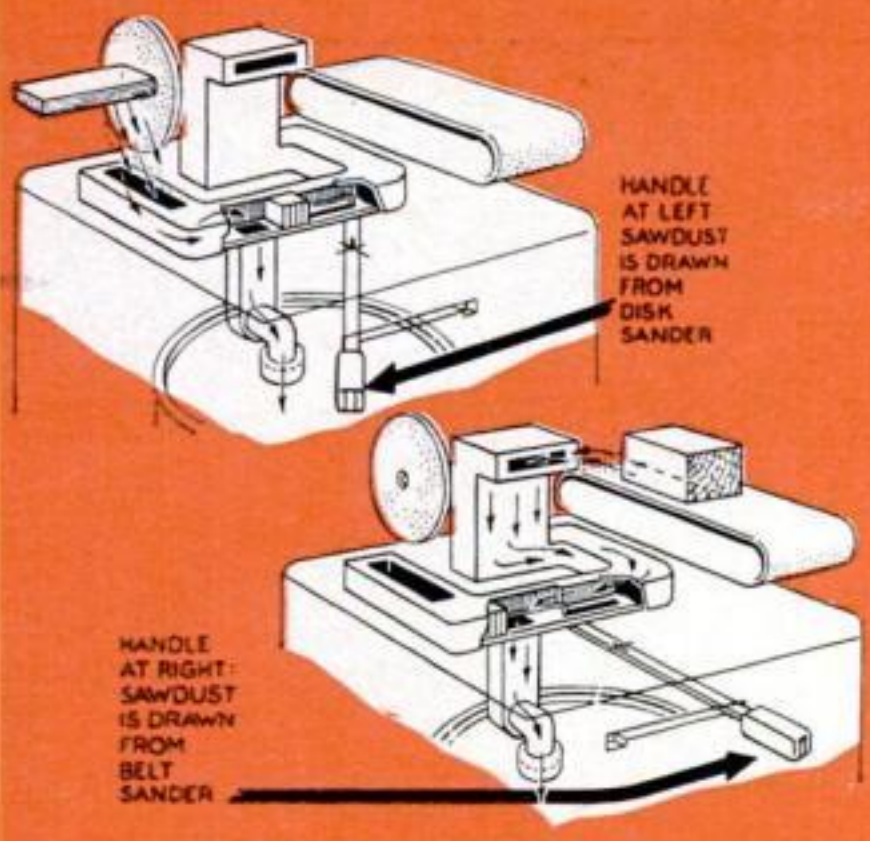


Neat appearance; clean performance: And the dividend of this handsome sander stand is a built-in dolly that lets you trundle the vacuum unit out of its niche and over to other shop machines in a jiffy.

Urheberrechtlich geschütztes Material

Since the total current draw is 14 amps, a 15-amp time-delay fuse will protect the circuit nicely.

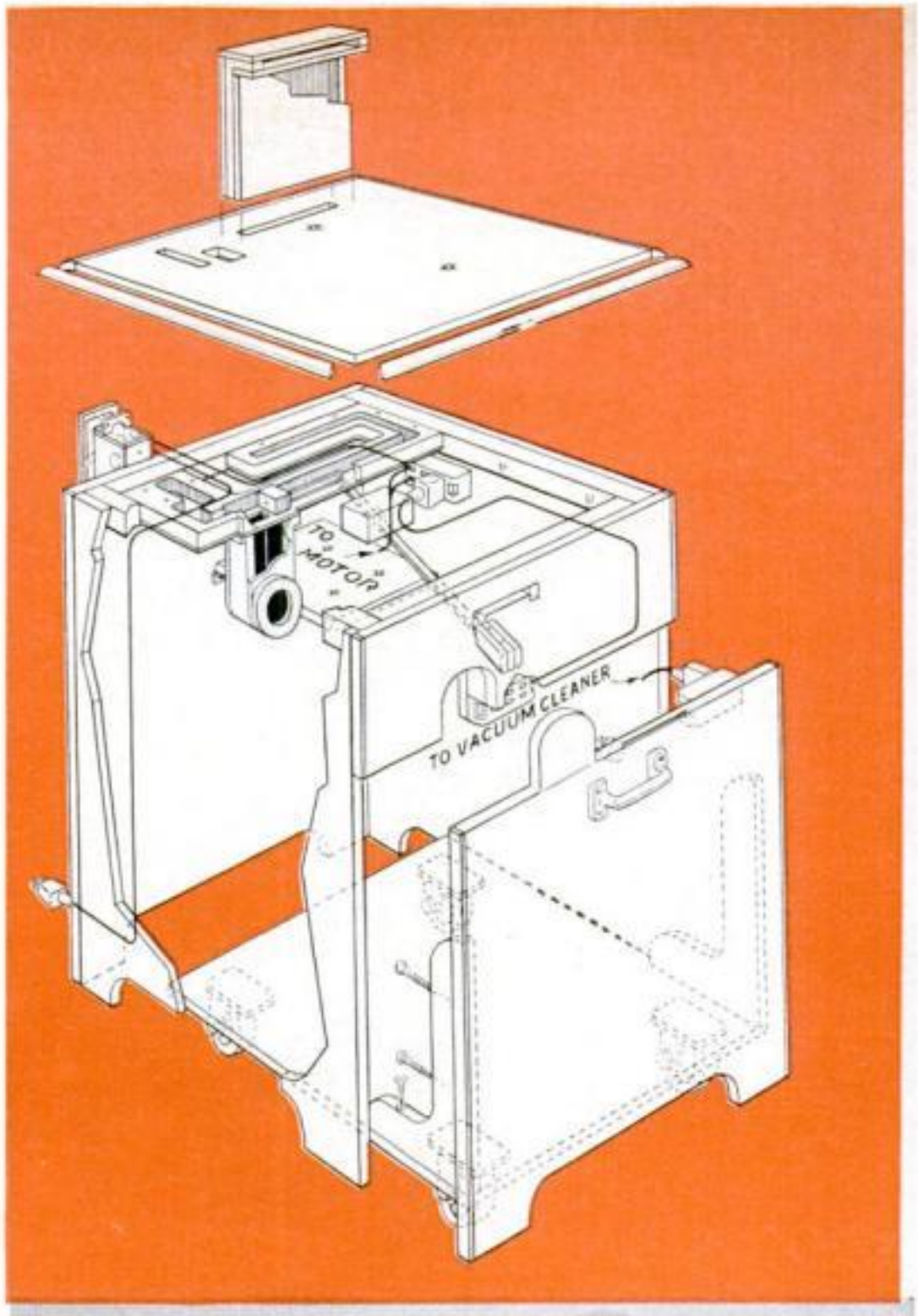
The perspective drawing at right shows the arrangement of the cabinetwork, the valve assembly, and the electrical hookup. Most of the structural members are cut from ¾" fir plywood, reinforced at the top with cleats made from 1¾"-by-1¾" fir. Note that all exposed plywood edges are covered, either with face strips (⅛"-by-¾" pine) or quarter-round molding. This improves appearance and protects the edges from possible splintering.

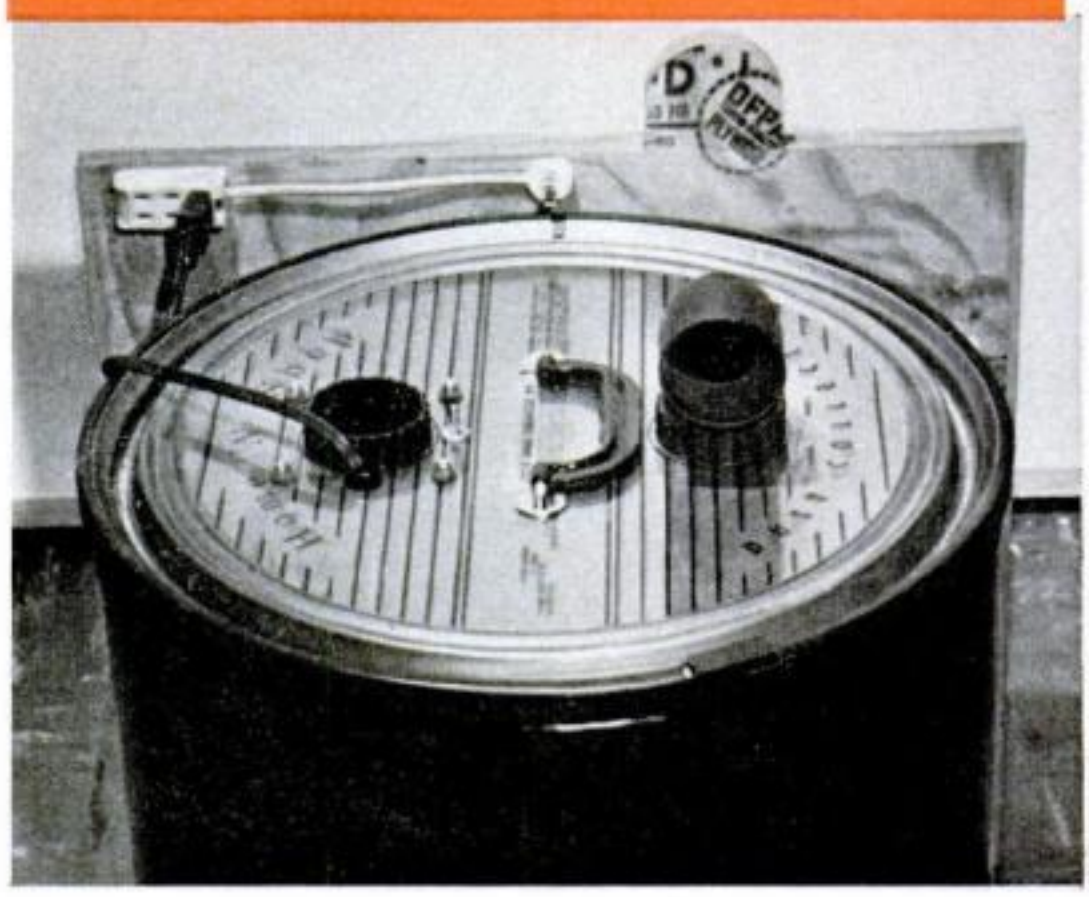
The dimensions of all parts are given in the profile drawings. They are based on a stand designed for a Sears combination 6" belt and 9" disk sander, teamed with a 15-gallon Home-N-Shop vacuum. Should you use other makes, you may have to change the measurements slightly. If so, remember these points: The vacuum canister must clear the upper part of the stand when the dolly is withdrawn. Its intake nozzle must align with a plastic-foam washer that forms a tight seal with the diversion valve. Finally, the ends of the valve-assembly ducts—and the slots in the table top above them—must be in direct alignment with the disk and belt sanders.

Making the diversion-valve parts. Again bearing in mind that dimensions may have to be modified, scale up the drawing on the opening page to form templates for the diversion-valve parts. Saber-saw the wood and plywood members to contour, and join them with brads and glue. The small block used for the valve should slide freely in its track, actuated by an L-shaped steel rod press-fitted into it.

The other end of the rod is engaged by a slot in a lever cut from ⅛"-by-½" steel bar stock. The pivot point for this lever is critical. To determine the correct "throw," turn the bench upside down. Then slip a wood screw through the pivot hole in the rod. Shift it about until you find the precise point in the mounting block for full valve travel. At the same time, the forward end of the rod should fit into the locking notches at the ends of the slot in the front of the stand.

Use a simple flapper valve made of sheet rubber to prevent an air leak where the valve rod passes through the slot. You can cut it from a strip of inner-tube rubber. One end is punched with a small hole that passes over the rod. The other end also has a hole





through which a big rubber band is looped.

This flapper should be placed on the underside of the diversion-valve assembly, with the valve rod passing through one hole before engaging the throw lever. The other end of the flapper is drawn completely across the slot and secured to a screw-eye with a rubber band. Held under constant

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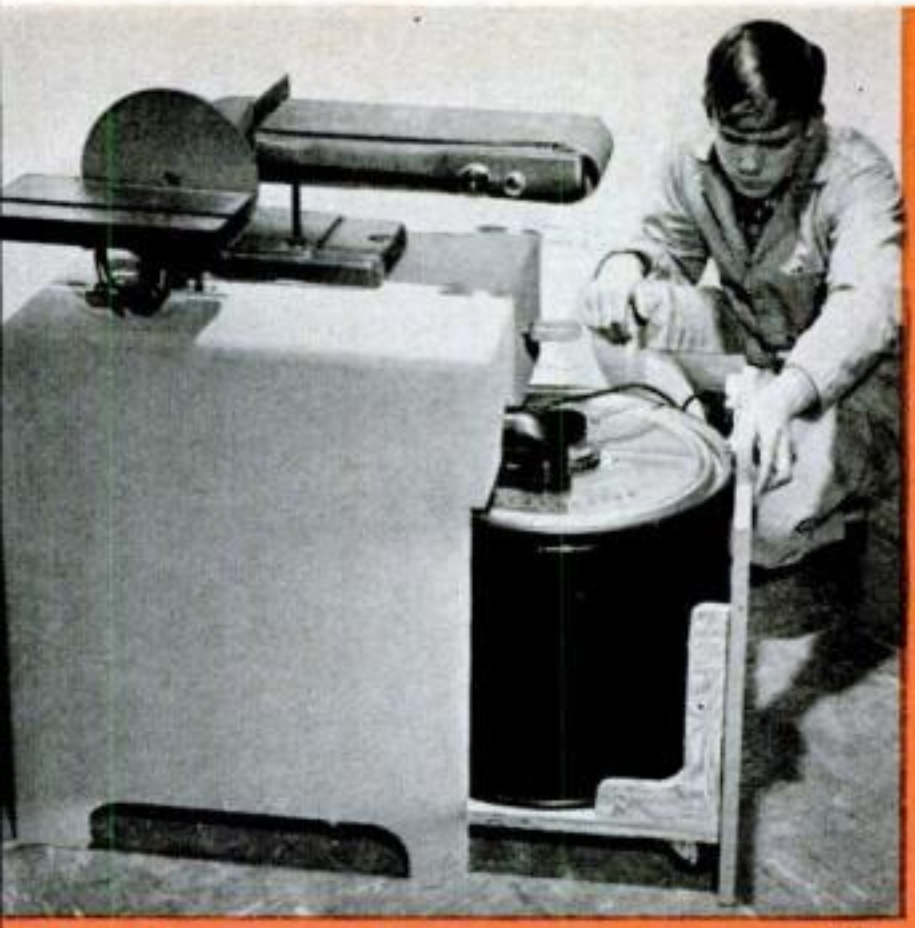

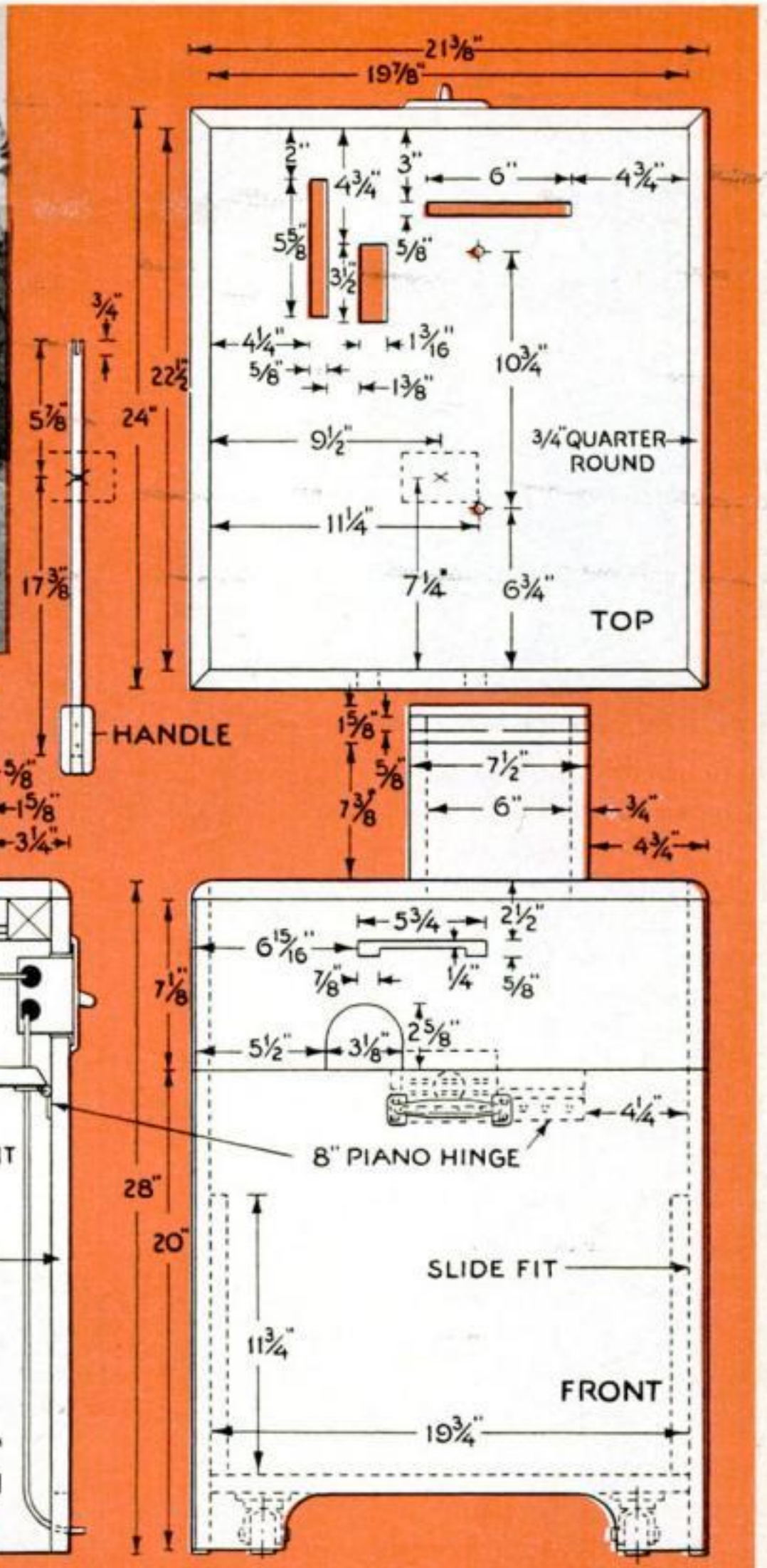

Electrical circuit to the vacuum cleaner is completed when the drawer-like dolly is positioned in the stand (perspective drawing at left, and photos). Sander motor is mounted on a hinged platform just above the canister.

For different makes of sander and vacuum, dimensions given in drawings above may have to be slightly modified. Firm measurements cannot be given, either, for the placing of the casters. Just be sure that you provide 360-degree swiveling clearance for whatever type you use.

tension by the band, it will seal the slot tightly whenever the shop vacuum is operating. The seal for the nozzle connector is cut from ½" polyurethane foam and glued to the nozzle face.

Electrically, the setup is simple. A toggle switch controls current to a surface-mounted duplex receptacle inside the cabinet. The sander motor plugs into one side, and a jumper connection takes off from the other to a second receptacle mounted on the front of the cabinet. This one is engaged by a flat disk plug when the dolly is shoved home. Again, a jumper line carries current to a third receptacle, into which the shop-vacuum cord is plugged. ■ ■

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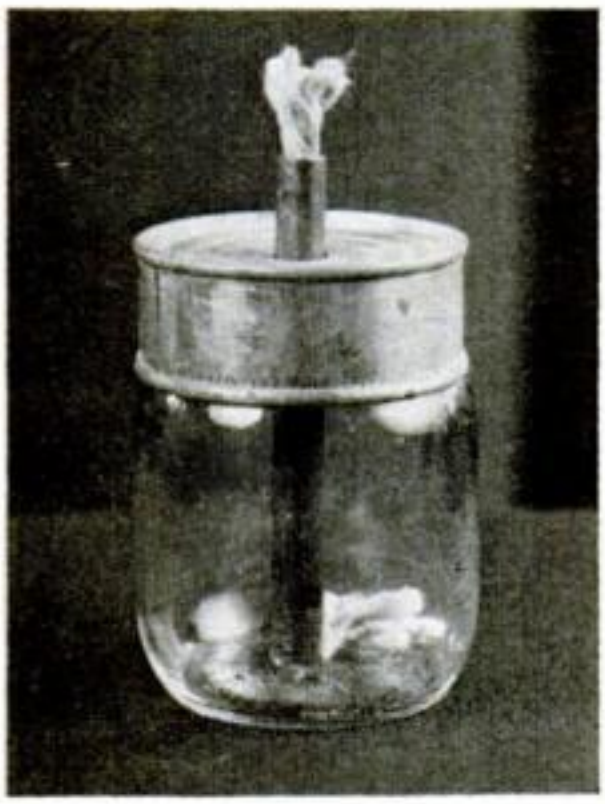
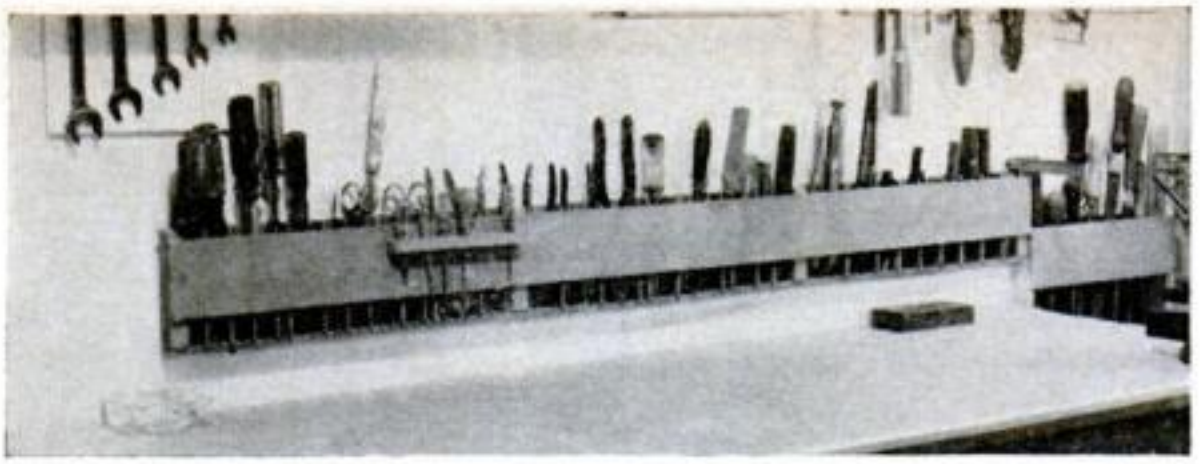
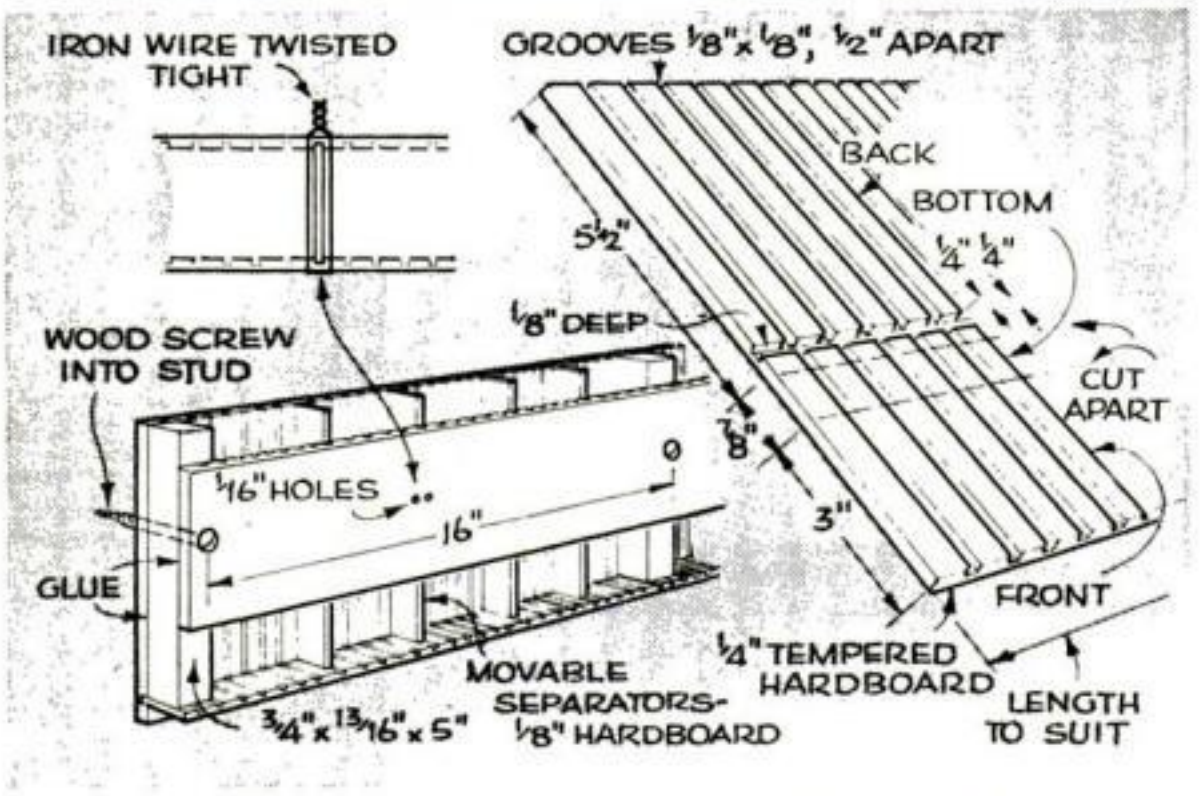
Short Cuts and Tips FROM PS READERS



Make an alcohol torch from scrap parts

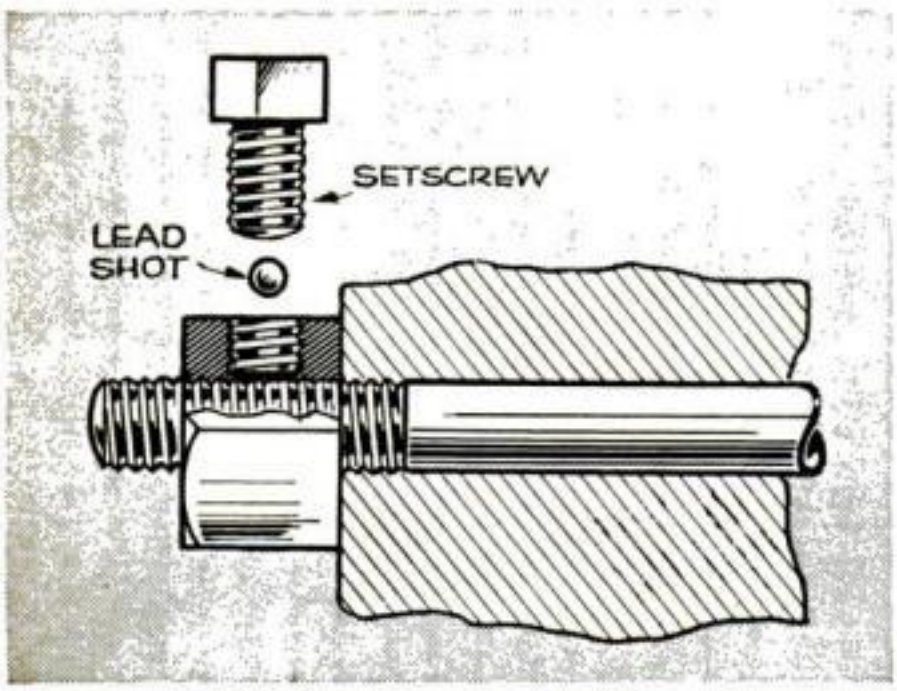
Most woodworkers have use now and then for stick shellac—it's handy to fill in scratches and blemishes in fine furniture. Heat is necessary to soften the shellac. I use an alcohol torch that I made from scrap—a relish jar, a minced-ham can with one end removed, ⅜" pipe, and wicking.—*John F. Marshall, Newburyport, Mass.*





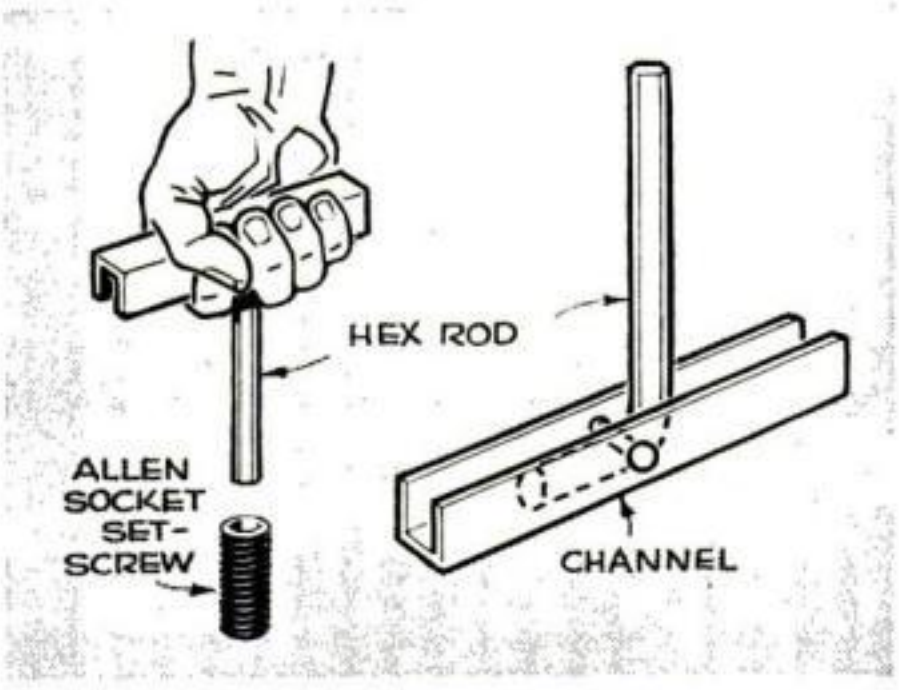
How to make a workbench caddy for small tools

Cabinetmakers used to park their small tools behind a leather strap loosely nailed at intervals to a board at the back of the bench. Here is a neater version of that idea. The pocket separators are all movable except one near the center, which is wired to keep front and back from bulging apart. Unless you have a saw or dado blade that cuts a slightly wider than ⅛" kerf, thin the edges of the separator strips slightly by sanding so they slip readily into the grooves.—*H. W. Teter, Menlo Park, Calif.*



BB protects threads under a setscrew

Where there's unusual vibration or shock, nuts or threaded collars must be locked in place with setscrews. To protect threads, drop a lead BB shot into the hole before turning in the setscrew. It will compress and hold securely.—*D. Bousha, Jackson, Mich.*



Handle for Allen wrench is handy

For extra leverage when using the long leg of an Allen wrench, make a cross handle. Groove a piece of hardwood about 2½" long and ½" square. Drive an escutcheon pin a bit off center through the groove and insert the short leg of the wrench as shown.

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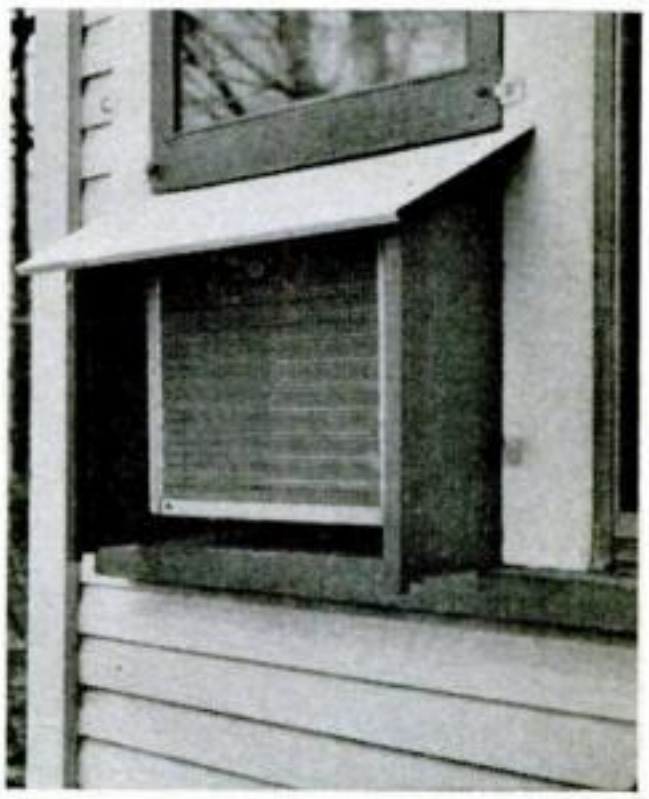
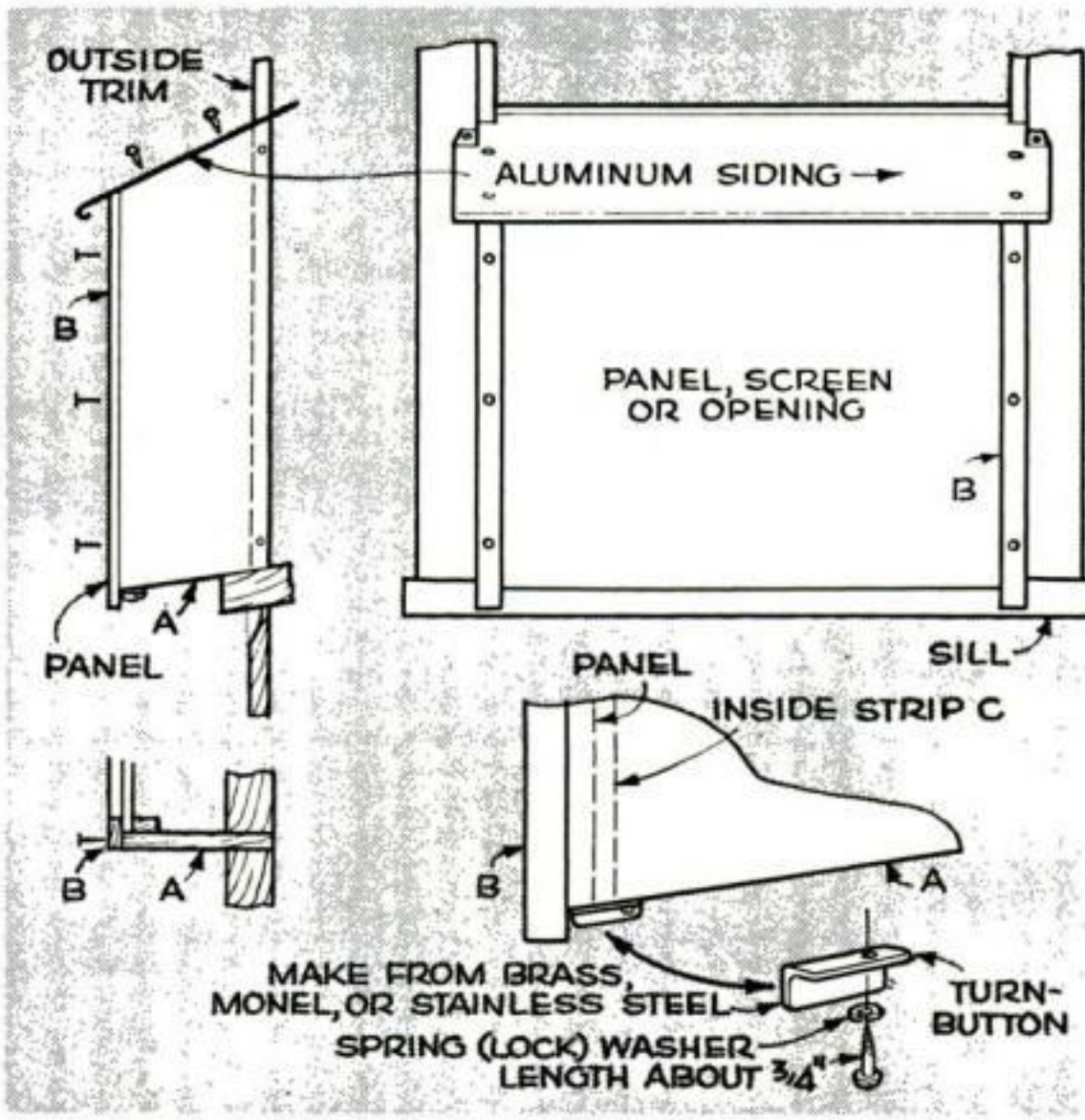


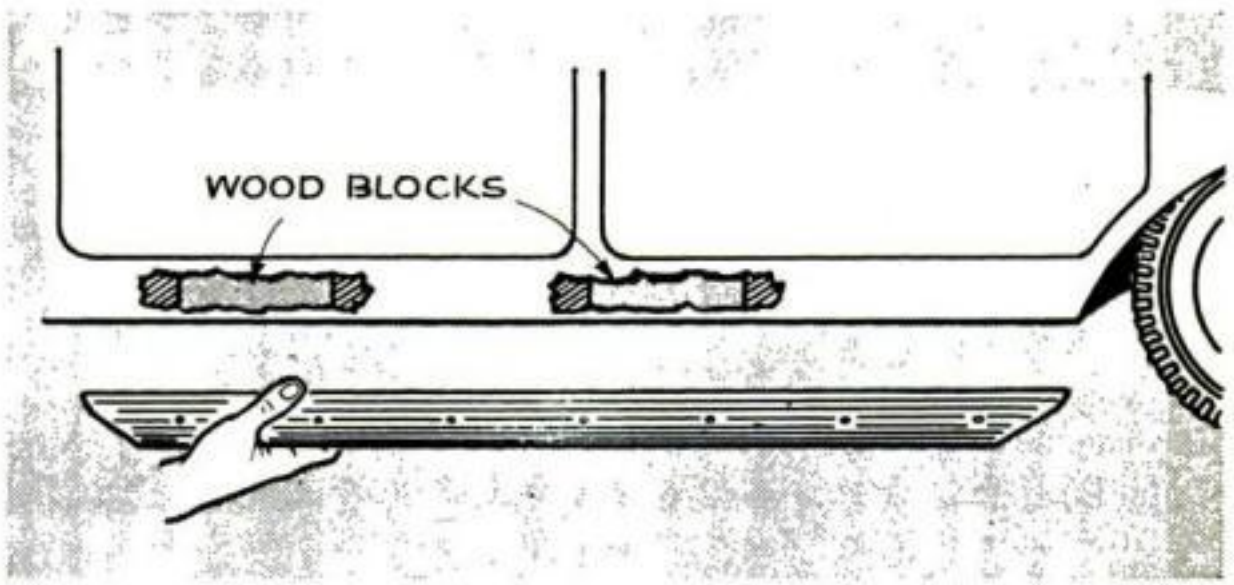
A protective enclosure for an air conditioner

A window air conditioner may last longer if protected from the elements. One home owner has done it as shown here. An easily removed hardboard panel gives winter protection. The enclosure began with slant-top wood members fastened to the window trim on each side with screws. The roof is a length of aluminum siding 8″ wide. The removable hardboard panel slides up into grooves formed as shown in the drawing. Two metal turnbuttons keep it in place during the winter. A wood storm window was shortened to go above the enclosure.—*Walter E. Burton, Akron, Ohio.*



Fix a solid grip for new rocker panels

Attaching new rocker panels on a badly rusted car can often be a problem when the existing panels are too worn to hold the screws. But blocks of wood fitted snugly inside the holes will give you a firm base for the new panels. —*William Sill, NYC.*



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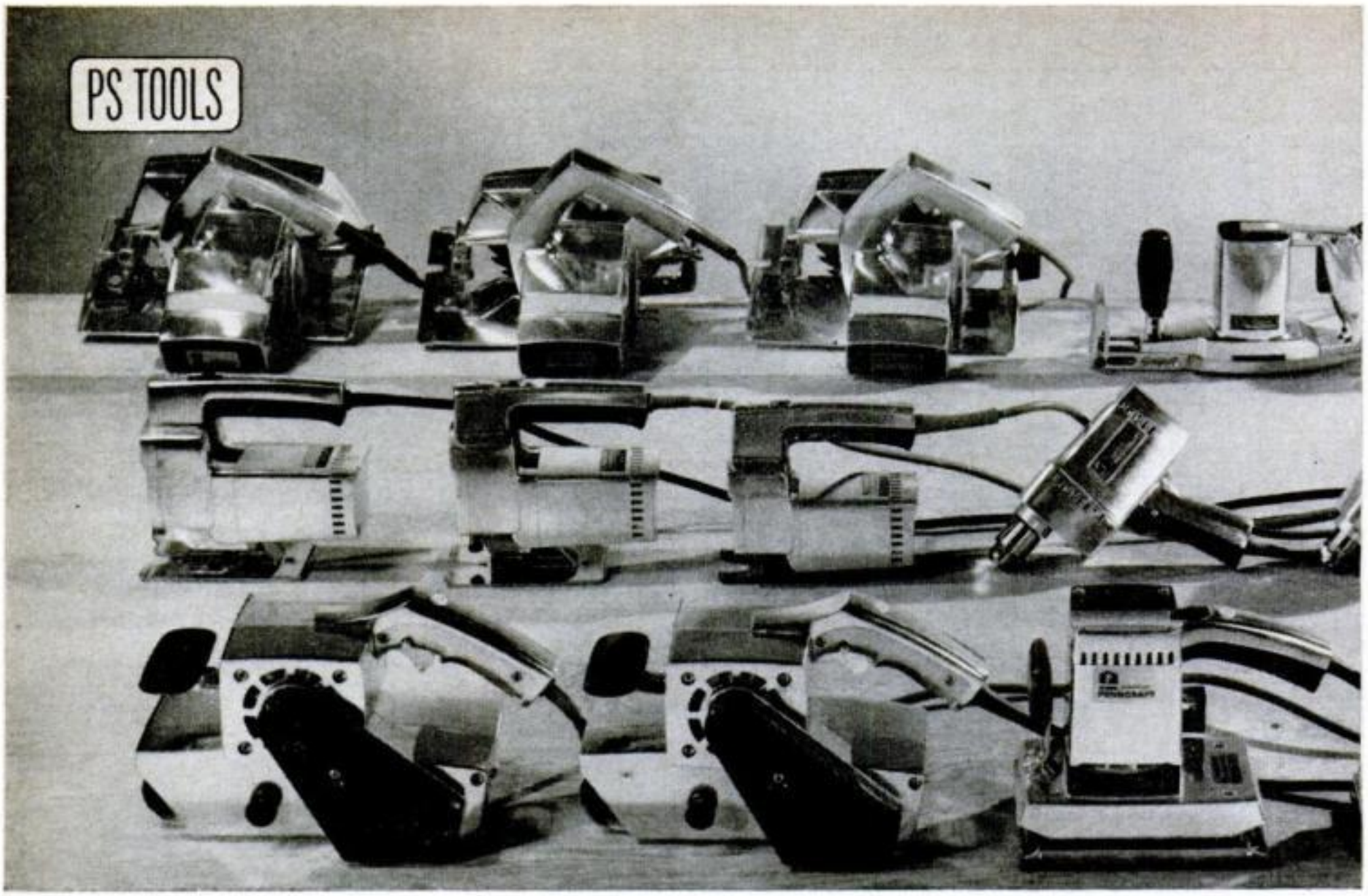

This sea of tools is part of J. C. Penney's big new line of portable power. Tools are deliberately

A New Line of Portable

Smart idea: Like buying a car, you have three models to choose

By Sheldon M. Gallager

WHEN you buy a power tool, you sometimes have to choose between a luxury-loaded high-priced model or a flimsy, frill-less "economy" job. There's nothing in between. The tools you see here are different. While there are several models and prices for each type of machine, there is often little or no difference between them as far as looks, general features, and quality of construction go. The differences are "under the hood"—in the power, speed, and gearing that each model offers.

It's like buying a car with three engine options. The car is basically the same, but you can have it with family economy or sports-car dash. You can choose the model that best suits your needs—without sacrificing other desirable features you want.

This is the thinking behind a new line of portable power tools introduced by J. C. Penney, the chain and mail-order store. The tools, known as the Penncraft line, include drills, routers, saber saws, circular saws, orbital sanders, belt sanders, and a horizontal-blade reciprocating saw. Penney's aim is to produce quality tools at moderate prices—and it takes the job seriously. It maintains a full-time, well-equipped testing laboratory in New York City devoted to the constant checking and improving of its designs.

Look-alikes that aren't alike. There are usually three models for each tool—a regular or economy grade, a middle-priced "custom" grade, and a top-priced "premium" grade. In drills alone, these add up to a

[*Continued on page 190*]

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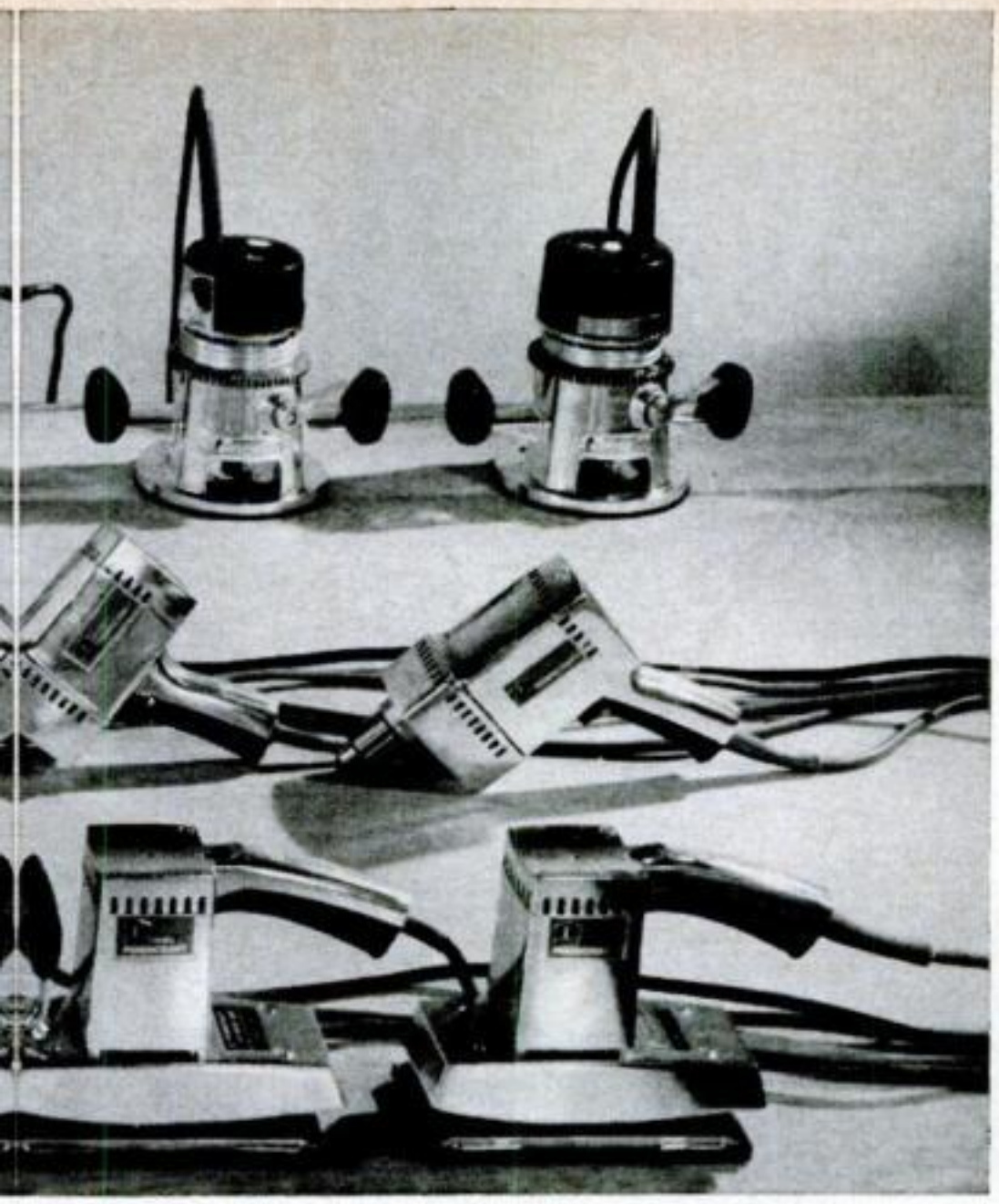
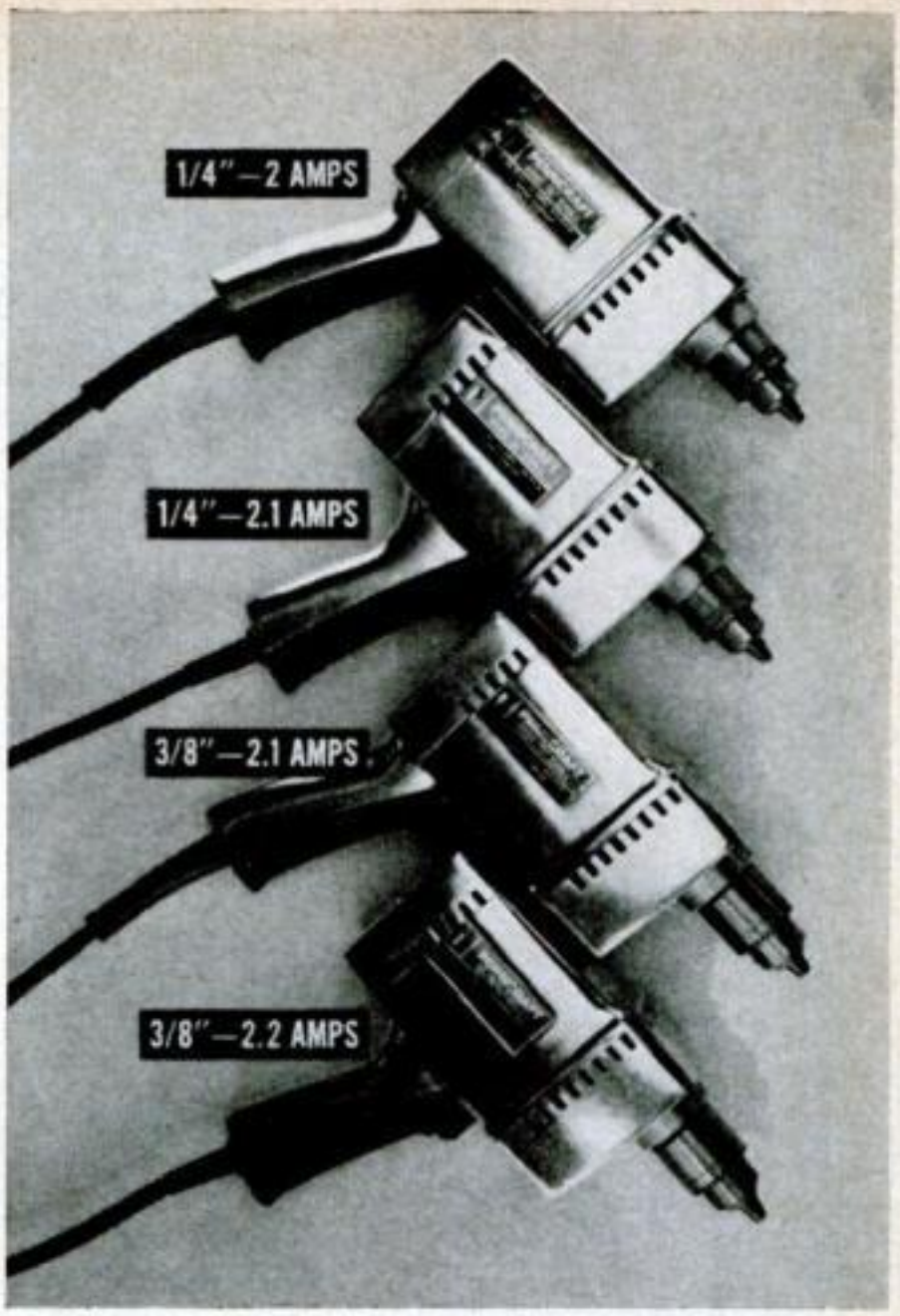


designed to look alike, offer similar features.



Identical looking except for a slight difference in handle location, the drills above offer four choices in speed and capacity. The idea: uniform features and construction with power options to suit the type of work done. Drills below are also identical yet range from ¼" capacity to ½" (½-incher was found to be gutsy for its size, the ¼-incher a bit cumbersome).

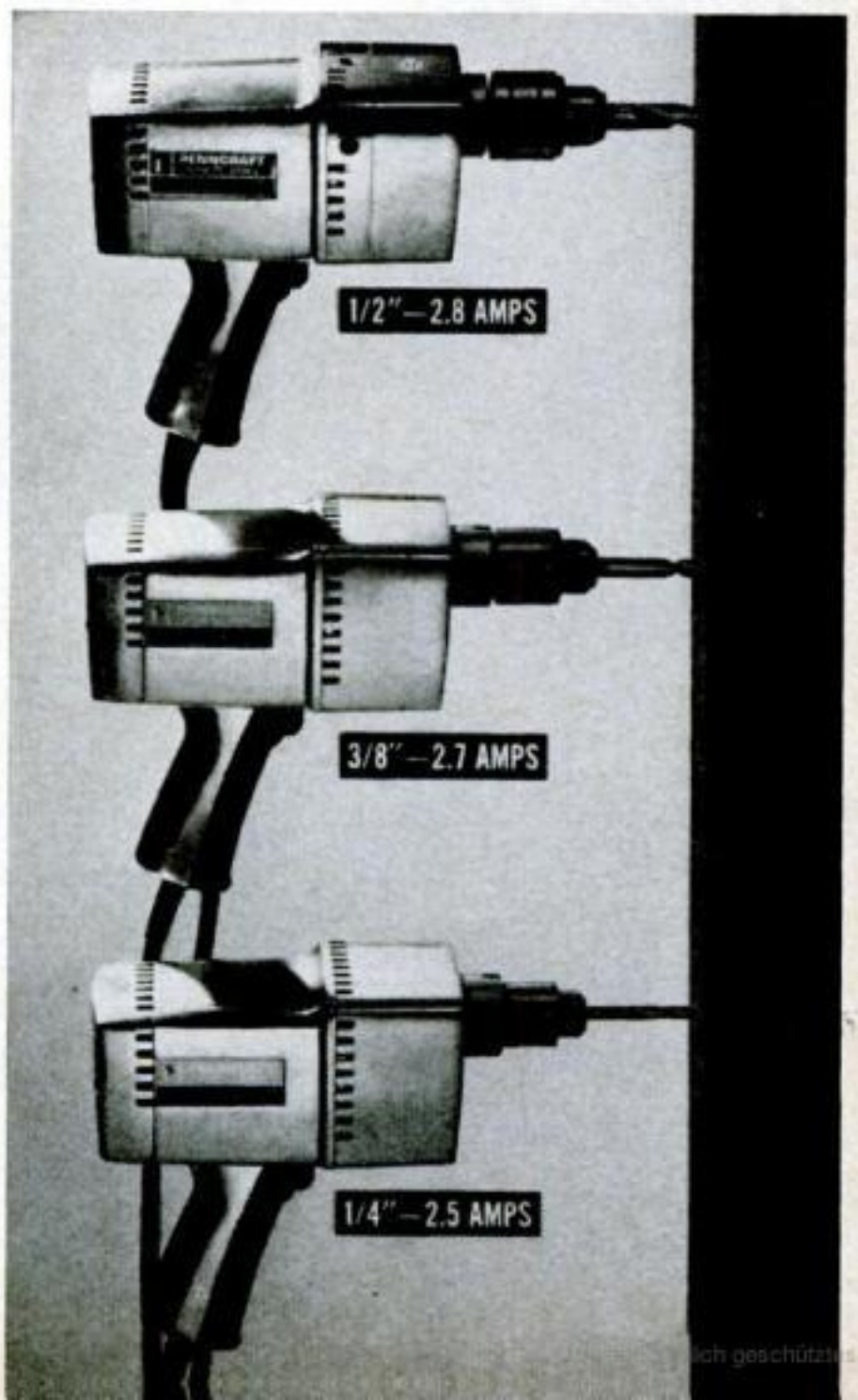
Power Tools

from—economy, standard, deluxe

How they compare

TYPE OF TOOL	APPROX. PRICE	RATED AMPS	OPERATING SPEED (no load)	TEST RESULTS (in seconds; see text for tests made)
¼" Drill (reg.)	$ 8	2.0	2,250 r.p.m.	59
¼" Drill (cust.)	$13	2.1	2,300 r.p.m.	58
¼" Drill (prem.)	$23	2.5	2,000 r.p.m.	9
⅜" Drill (reg.)	$15	2.1	1,000 r.p.m.	15
⅜" Drill (cust.)	$20	2.2	1,000 r.p.m.	11
⅜" Drill (prem.)	$26	2.7	1,000 r.p.m.	6
½" Drill (reg.)	$27	2.8	650 r.p.m.	21
½" Drill (cust.)	$37	3.5	425 r.p.m.	46
½" Drill (prem.)	$49	4.5	425 r.p.m.	33
Orb. sander (reg.)	$16	2.0	3,500 o.p.m.	60
Orb. sander (cust.)	$19	2.2	4,000 o.p.m.	69
Orb. sander (prem.)	$30	2.5	4,600 o.p.m.	47
3" Belt sander (reg.)	$33	5.5	850 f.p.m.	50
3" Belt sander (cust.)	$48	5.5	850 f.p.m.	56
4" Belt sander (prem.)	$69	9.0	1,350 f.p.m.	not tested
7" Cir. saw (reg.)	$29	9.0	5,000 r.p.m.	2.5
7" Cir. saw (cust.)	$39	9.5	5,000 r.p.m.	2.5
7½" Cir. saw (prem.)	$58	11.0	5,000 r.p.m.	2.25
Saber saw (reg.)	$15	2.2	2,700 s.p.m.	21, 28
Saber saw (cust.)	$25	2.5	3,000 s.p.m.	30, 39
Saber saw (prem.)	$33	3.0	3,000 s.p.m.	14, 28

Notes: o.p.m.—orbits per minute
f.p.m.—feet per minute
s.p.m.—strokes per minute



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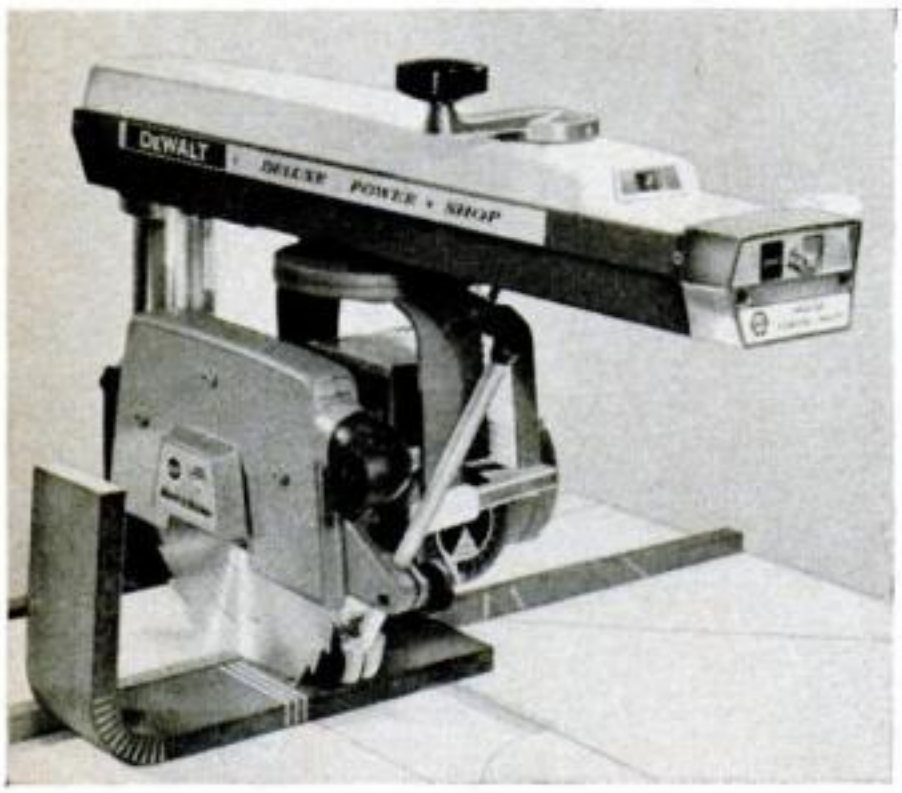
SHOP TALK

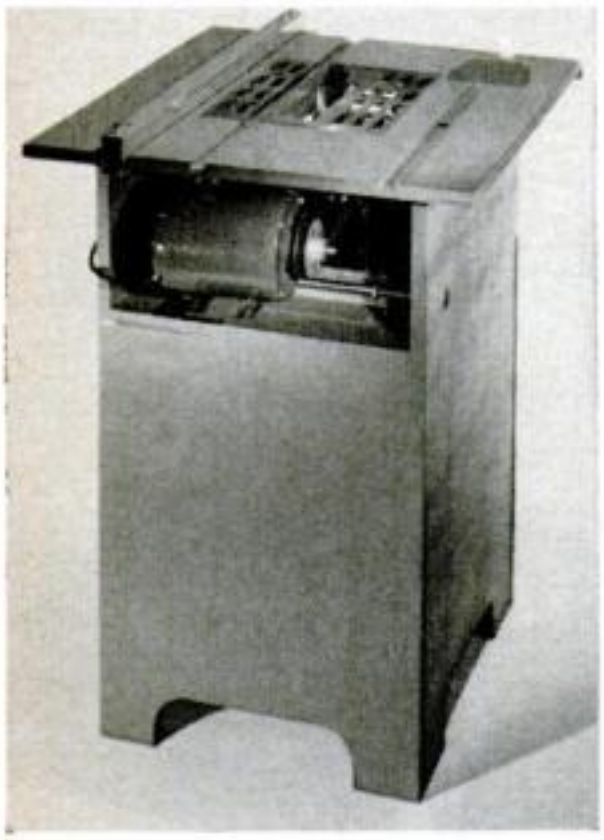
By Sheldon M. Gallager

Now: A brand-new DeWalt radial-arm saw

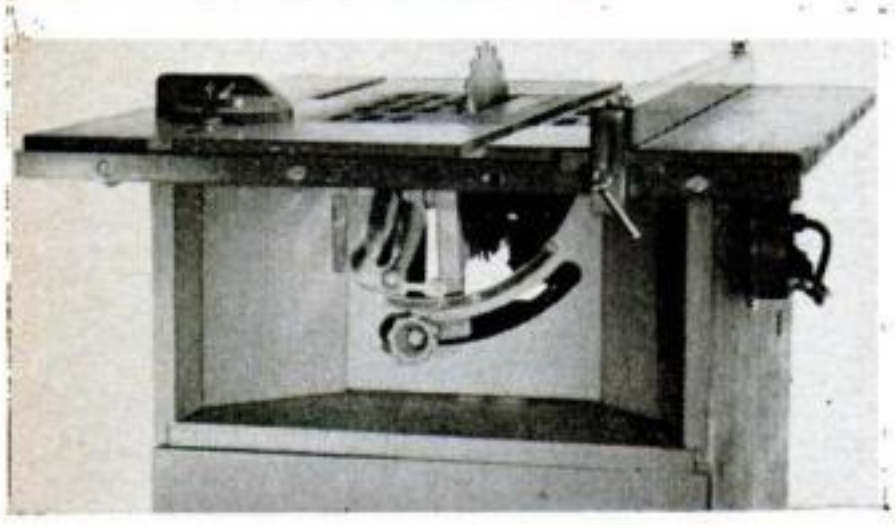


The shiny, streamlined radial saw you see at left is the first all-new DeWalt to appear since Black & Decker took over the famous name several years ago. Completely redesigned, it promises some exciting innovations. Aside from slicked-up styling, its biggest features are up-front controls for easy access. The blade-height handle has moved magically out from the rear of the arm. Rip, miter, and bevel controls are also in front and are single-action levers that can be worked with one hand (you don't have to hold one thing while moving another). The miter scale shows up in a little window on top of the arm so you can set up for angle easily without stooping. The 10″, 2½-hp. saw will sell for about $280. There's also a less fancy 9″ model for $200. We haven't had a chance to try the new saws yet, but hope to be able to bring you a personal-use report on them in a future issue of PS.

How to turn a small saw into a big one



The American Machine & Tool people, noted for their moderately priced power tools, have come up with a smart idea for their little $14.95 table saw. Anyone who buys the saw gets a free set of plans for building it into a big, roomy bench cabinet. The cabinet, shown at left, increases the saw's table area to a generous 24″ by 27″ and provides a dust-collecting bin under the saw plus additional space for storing accessories. A special extra-length rip fence and guide rail to fit the enlarged table are available for $4.50. Add the cost of a sheet of ¾″ plywood for the cabinet and you have a floor-model table saw for about $26. You can't ask much more than that.



The saw is essentially the same model that PS tested a few years ago and found to be a good buy for the money. The motor (not included) slides on a rail behind the saw (upper photo)—a clever design that permits the blade arbor to tilt. The controls are recessed in front, out of the way (lower photo). For anyone looking for an inexpensive machine with good table capacity, this saw-plus-cabinet deal is a nifty. You can learn more about it from American Machine & Tool Co., Royersford, Pa.

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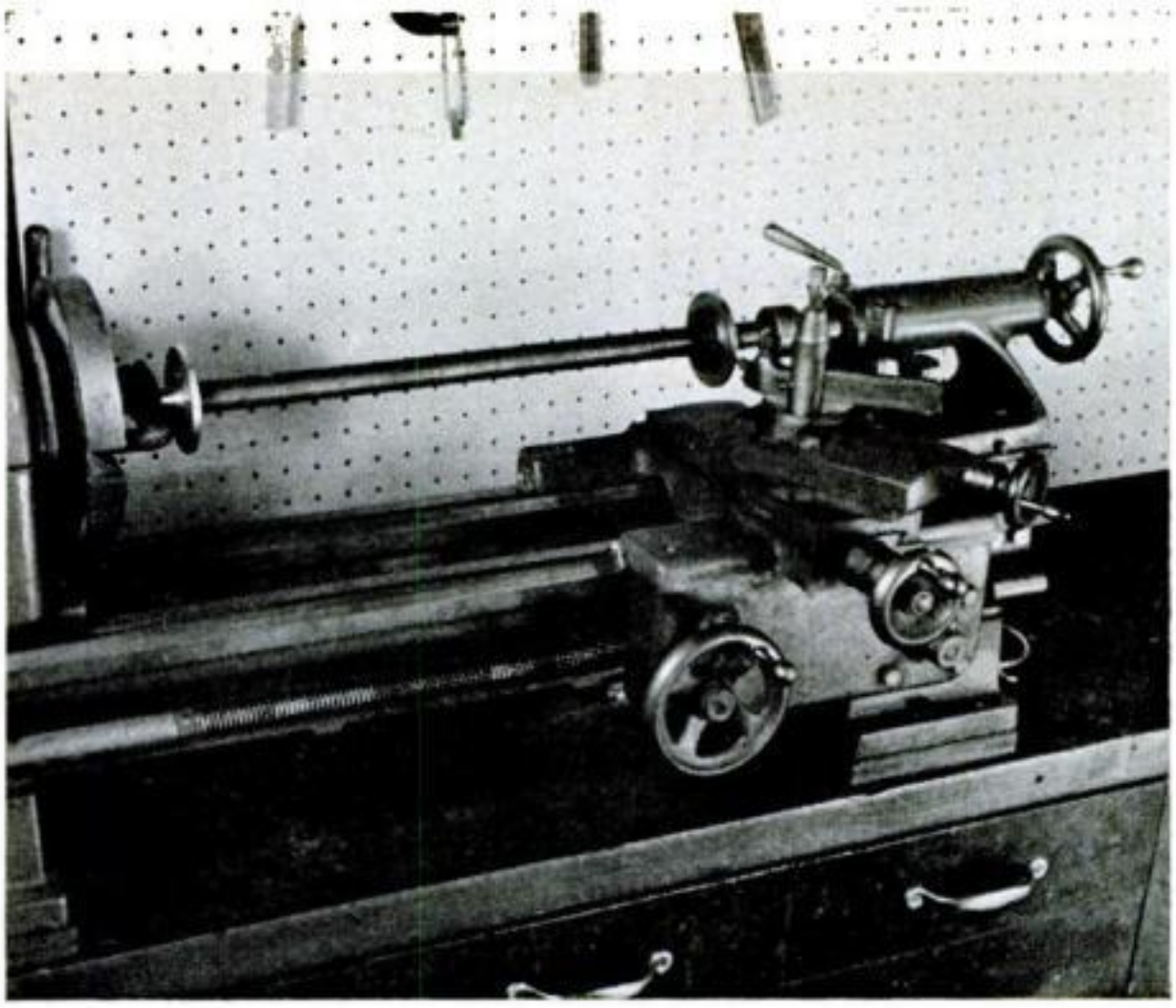
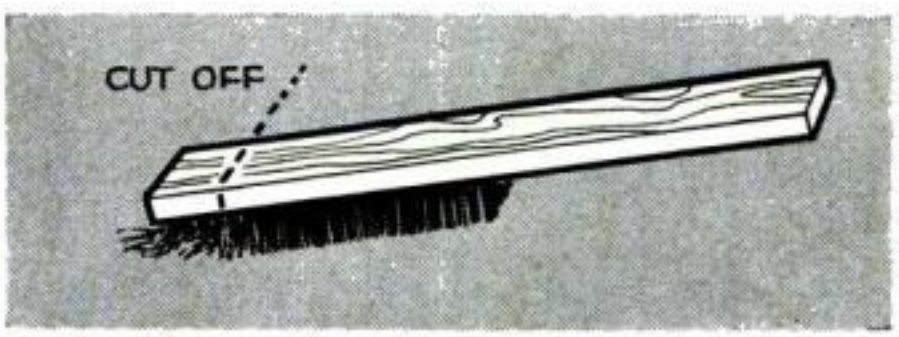


Short Cuts and Tips FROM PS READERS

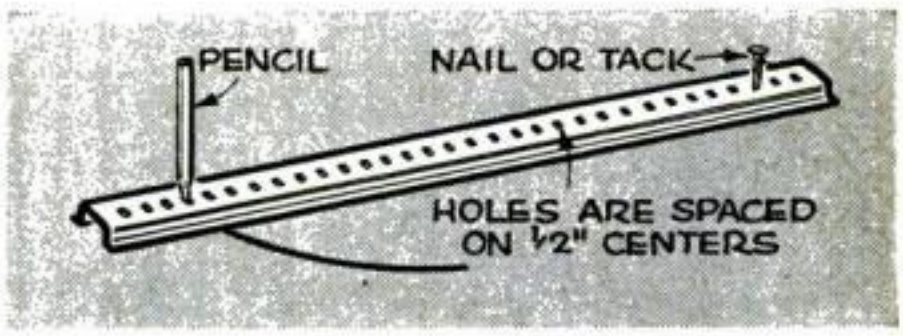
How to make a check bar for lathe work

Weld large washers on the ends of a small rod and you have a handy check bar for realigning a lathe tailstock after taper work or for routine checking of centers. Choose a rod slightly larger than the hole in the washers and turn down shoulders for about 2″ at each end. These make it easy to weld on the washers so that they'll run true.—*Gordon Williams, Sacramento, Calif.*



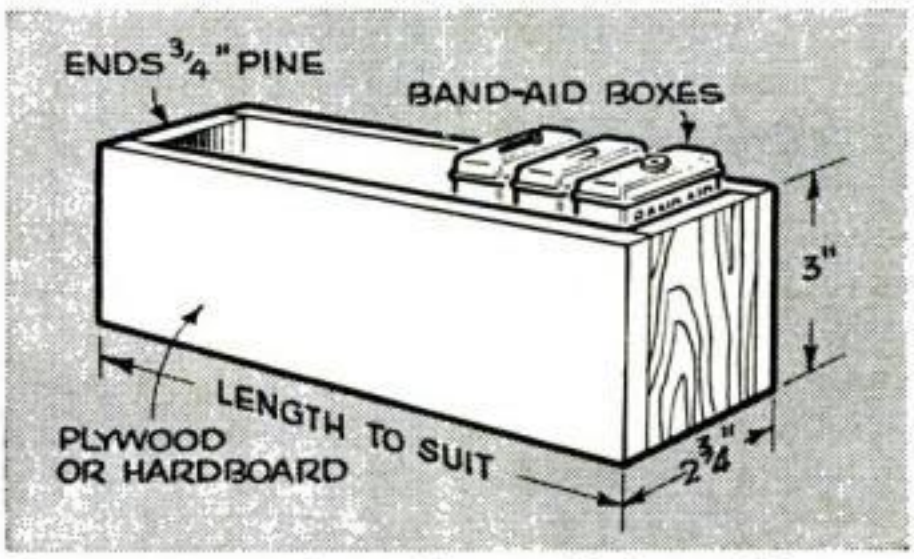
A tip: Cut off wire-brush tip

Wire brushes tend to wear down at the end. The end then keeps the remaining good bristles away from the work at hand. The solution is simple: Just cut off the worn bristles and backing. You can do this several times.—*A. Weber, Edmonton, Can.*



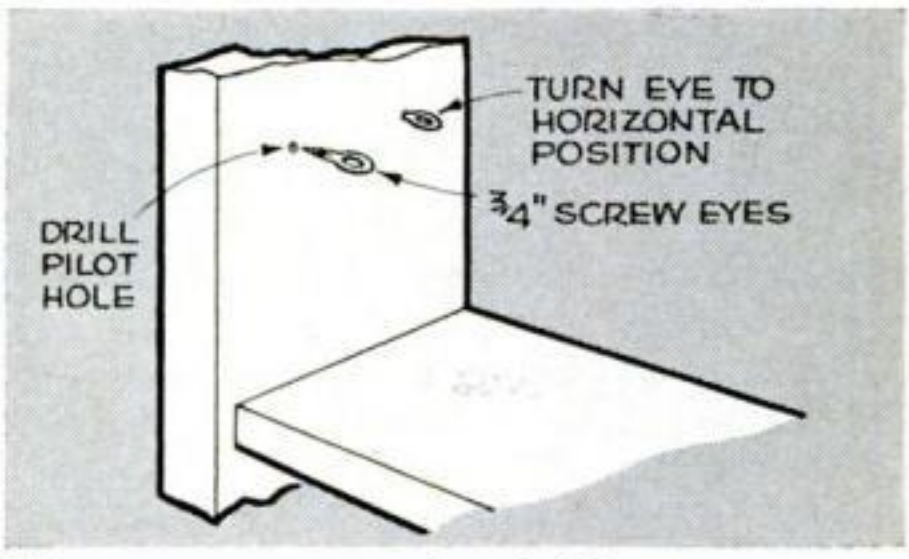
How to draw an arc of large radius

Next time you have to draw an arc, or circle, of large radius—even up to 6′—check around the house for a metal shelf standard. If you have one, it'll make a fine substitute for a compass. Use it as shown above.—*Barton Friend Jr., Pittsburgh.*



Shop storage from the medicine cabinet

A collection of Band-Aid boxes is one of the handiest storage aids in my home workshop. I keep various small repair items—faucet washers, staples, tacks, and brads—in them, with an identifying item cemented atop each lid. The boxes are all stored in a wooden box made as shown in the sketch above.—*F. L. Reynolds, Salina, Kans.*



Big screw eyes make shelf supports

Lost some of the shelf pins from a bookcase, or need some for a shelf you're building? Large screw eyes make very strong supports. Though they're not as easy to shift as the conventional loose kind (you have to drill pilot holes for the screw eyes) they will support much more weight.—*S. L. Walton, White Plains, N.Y.*

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How to Cure an Oil Hog

Blue-gray clouds from your car? Don't fret. If it's a

By Angus Laidlaw

AFTER long and faithful service, your older car will eventually start to use more oil than it did in its palmier days. But this need not make you pour heavy oil in the crankcase or turn the car in and take a bad beating on the trade.

If the car is in reasonably good shape, and if it is a fairly late model, even high mileage probably does not mean you are in for an expensive engine overhaul. Chances are good your oil hog's problem is not piston rings.

The reason is simple. For the past five years and more, many U. S.-built cars have been using chrome-faced rings. Chromed rings have added so greatly to both ring and cylinder-bore life that rings rarely cause oil burning in today's cars.

So, if your car has become an oil hog, don't blame the rings. There are plenty of other places where the oil can go, and all of them are easier and cheaper to fix.

The leak problem. Just one drop of oil leaking out in 15 feet of driving costs you a quart for every 125 miles, even if the engine is burning no oil at all. And an engine that burns no oil is probably not nearly as efficient as it should be because no oil is reaching valve guides or upper cylinder bores. Without lubrication here, you could be driving to a high-speed engine seize-up.

Leak-spotting is tough on a dirty, oily engine. So get the engine compartment steam-cleaned or use a spray can of engine cleaner; let it soak in, and hose off the crud. Chances are that your oil leaks, if any, will then show up as soon as you run the engine. If leaks are hard to spot, get some engine-

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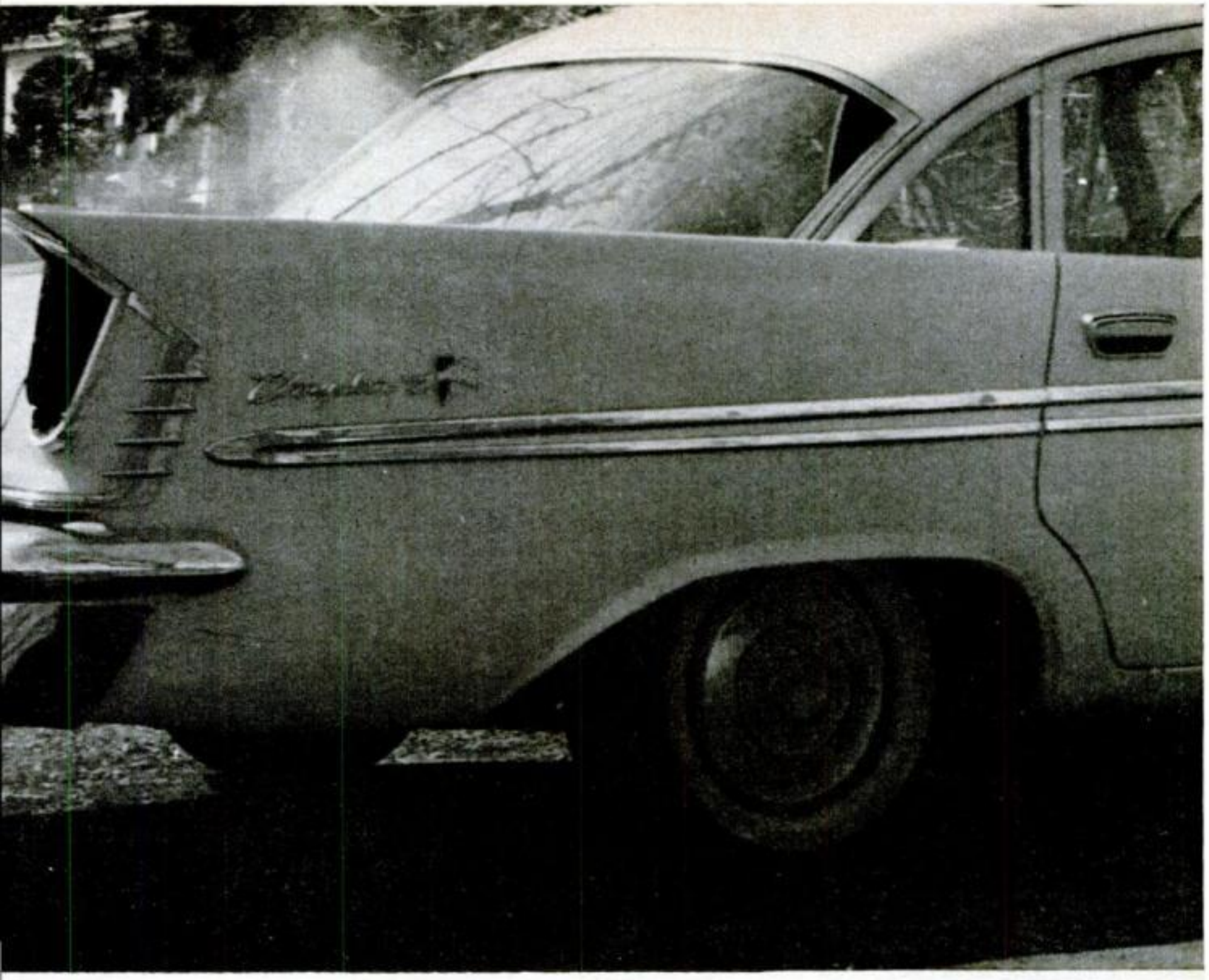

late model, you probably do not need new piston rings

oil dye from an auto-supply store. Look at every gasketed joint to see where the color shows up. Likely places: valve cover, oil pan, timing case, tappet-chamber cover.

Leak-fixing may call only for tightening the offending cover plate down to recommended torque-wrench settings. Often this doesn't work on an older car, but it is worth trying. If it doesn't do the job, you'll have to replace the bad gasket. This costs little and should solve most gasket-leakage problems.

Is oil leaking from either the clutch housing or the front of the oil pan? Then you may have a bad main-bearing oil seal or a clogged oil slinger on the crankshaft. On most cars these seals can be replaced or the oil slinger cleaned out simply by dropping the pan.

Any condition that can cause positive pressure to build up in the crankcase will also cause seal leaks and possibly gasket leaks. Blow-by past the piston rings causes pressure build-up when oil breathers, road-draft tubes, or positive-crankcase-ventilation (PCV) systems are plugged. In this case the cure is to make sure that vents are clear, and that the PCV valve is working properly.

What's it cost? Once you have cured your oil leaks, you may find that your oil-consumption problem has been reduced to the point where you can live with it. Even at 60 to 80 cents a quart and a quart every 200 miles, you are only paying $4 every 1,000 miles of driving. Just owning and repairing most cars will run you anywhere from a minimum of $20 to as much as $50 or more for 1,000 miles, so a small extra expense for oil adds comparatively little.

Maybe your engine is not leaking a drop,

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yet the oil is still going down on the dipstick about a quart every 150-200 miles. What's more, there is a cloud of bluish-gray smoke behind the car. So you know oil is being burned. There are plenty of ways it could be getting into the combustion chambers without going past the rings.

Take a closer look at your smoke cloud. White smoke is water vapor, not burned oil. Black smoke, which shows up mostly on acceleration, is gasoline and indicates a rich mixture. Here the fix may be a simple screw adjustment or, at worst, a rebuilt carb.

But bluish-gray smoke does mean that the engine is burning oil. Check this out by warming up the engine thoroughly, letting it idle for a few minutes, and then flooring the accelerator for an instant. A cloud points to oil in the combustion chambers. An easy road test is to follow the oil hog in another car and watch for bluish smoke whenever it decelerates, especially down a steep hill. High vacuum will really slurp up the oil under these conditions and you can see it burn. Or drive the oil hog yourself at about 40 m.p.h., take your foot off the gas, let it slow to about 20—and then floor the accelerator. A big puff of bluish smoke tells the tale.

Even if you see quite a bit of smoke, don't panic. Unless it is a really embarrassing cloud, chances are that you can reduce it to reasonable proportions without getting on the hook for a major engine repair.

Did your oil hog begin its swinish behavior suddenly? If your problem began suddenly, the cure may be quick and easy. A common cause of sudden oil burning is a cracked diaphragm in the vacuum-booster section of a duplex fuel pump (diagram at right shows how the oil gets slurped into the intake manifold). Gradually increasing oil burning, too, which you may attribute to general mechanical wear, may be due to the duplex pump. Sometimes the diaphragm becomes porous; when this happens, the engine burns oil.

To test the vacuum-booster pump, disconnect the vacuum line to the manifold and plug the pipe. Drive about 10 miles. No smoke? You've found the problem.

Valve troubles. Another prime source of oil burning is worn valve guides, particularly intakes. If the clearances around the valve stems are excessive, manifold vacuum can suck oil down past the stems in great quantities. The test is to cut off the oil supply to the valves and see if the oil-burning stops (see drawing of valve guides).

If you can't cut off the supply easily, try running the engine at fast idle with the valve cover off and squirting oil at the intake-valve stems with a pump oilcan. If you get smoke, you've found the culprit.

If your problem is valve-guide wear or worn valve stems, you can probably solve it without major work. Valve-stem seals are available for most U. S. (and some foreign) engines. Often these can be installed without removing the cylinder heads. Even if the head (or heads on a V-8) must come off for the job, a machine shop can do it for about $10 a head.

Gasket leaks can also let oil get into either the combustion chambers or the intake manifold and cause oil burning. Head gaskets can leak oil. Some V-8 engines have intake-manifold gaskets between the manifold and the cylinder head inside the rocker-arm housing. If this is the case, a leaky manifold gasket can cause oil burning. Look for oil-fouled spark plugs in cylinders adjacent to the oilway in the case of the head gasket, and for traces of oil in the cooling system or water in the oil. Check out the manifold gasket by removing the valve cover and squirting oil along the joint while running the engine. Extra smoke points to this source.

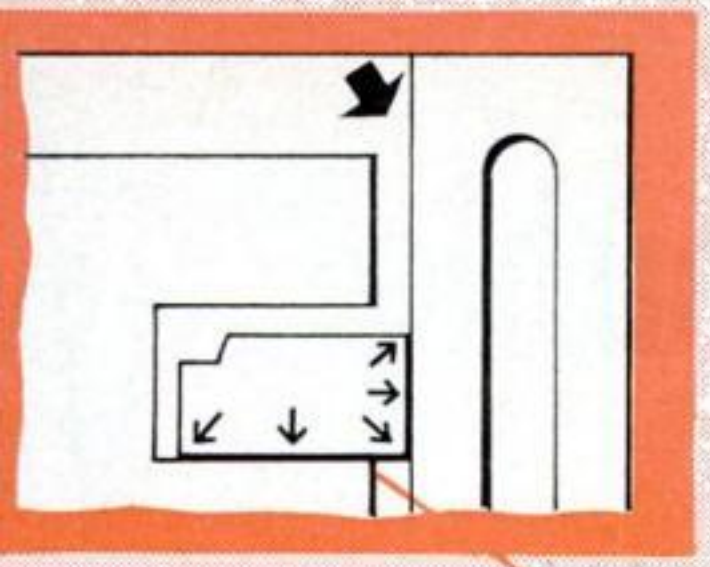
Cars built with PCV systems fall prey to all sorts of ills. Besides rough running, poor gas mileage, excessive combustion-chamber deposits, and contaminated oil, a plugged PCV valve can cause high crankcase pressures. Excessive turbulence or pressure buildup can also mix oil droplets with the crankcase vapors that the system is designed to remove.

Maybe it's the rings. There is a chance that your rings really *are* worn, or that engine bearings are worn to the point where they permit more oil to reach the cylinder bores than the rings can handle. This is more likely if your car is one of the small-engined imports that turns many more revs per mile than do the bigger U. S. cars. Still, even if some of the oil is being burned after passing the rings, there is a good chance that repairs you have made to cure other causes will reduce the problem so you can live with it.

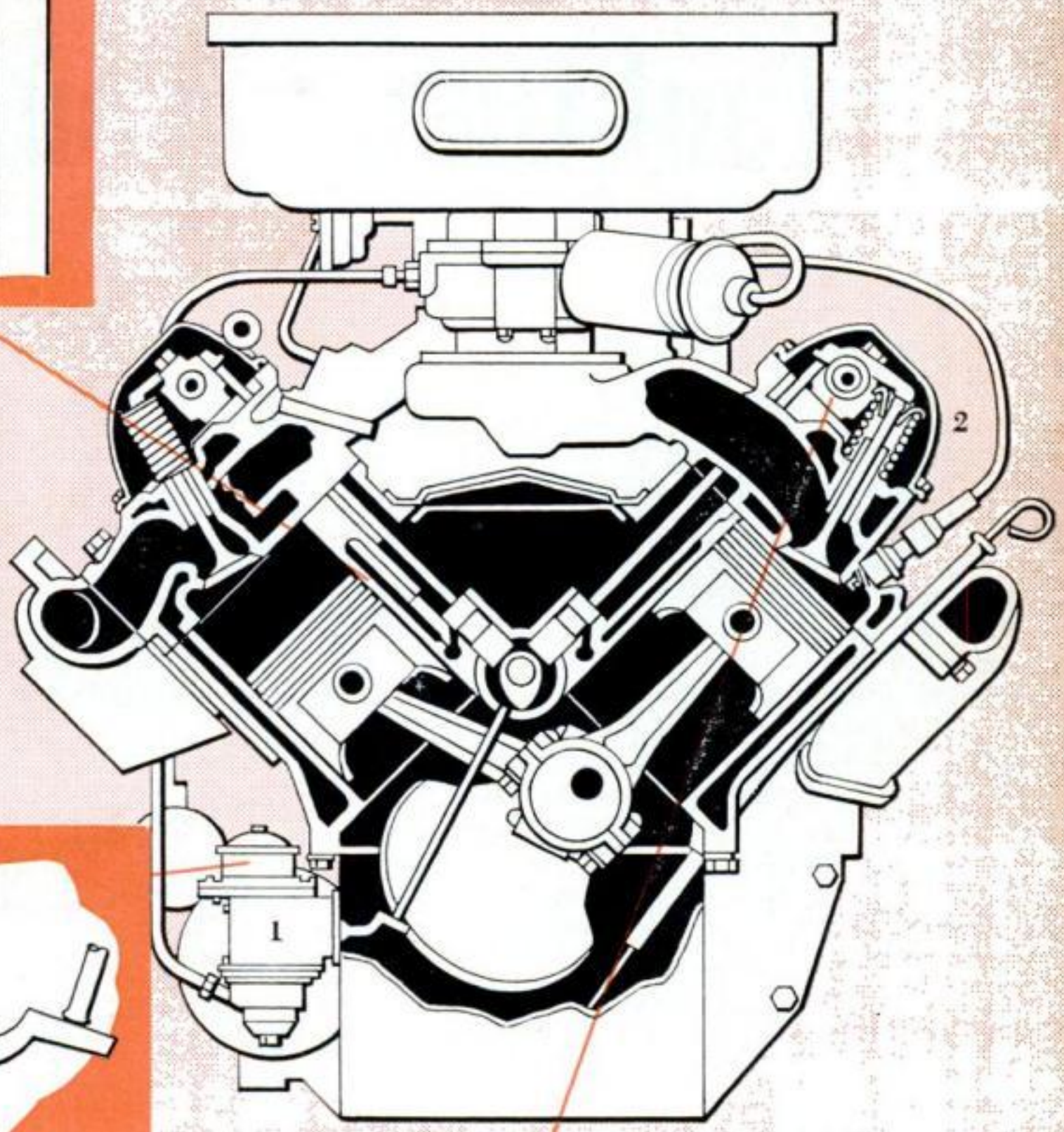
If you are interested in doing your own major engine work, get a manual for your car and a "Service Manual for the Doctor of Motors" ($1.50 from Perfect Circle Div., Dept. PS, Dana Corp., Toledo, Ohio). ■ ■

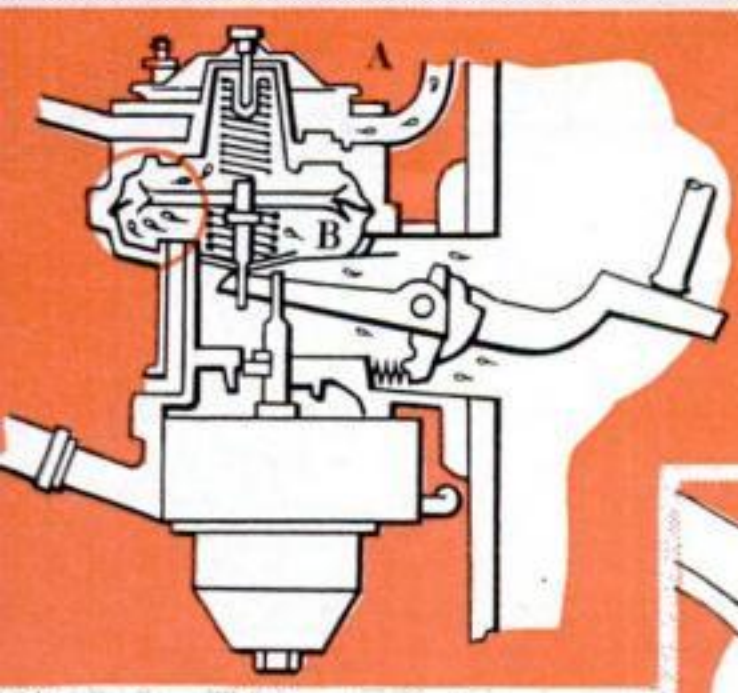
Urheberrechtlich geschütztes Material

Here are the main oil-loss points and cures for them

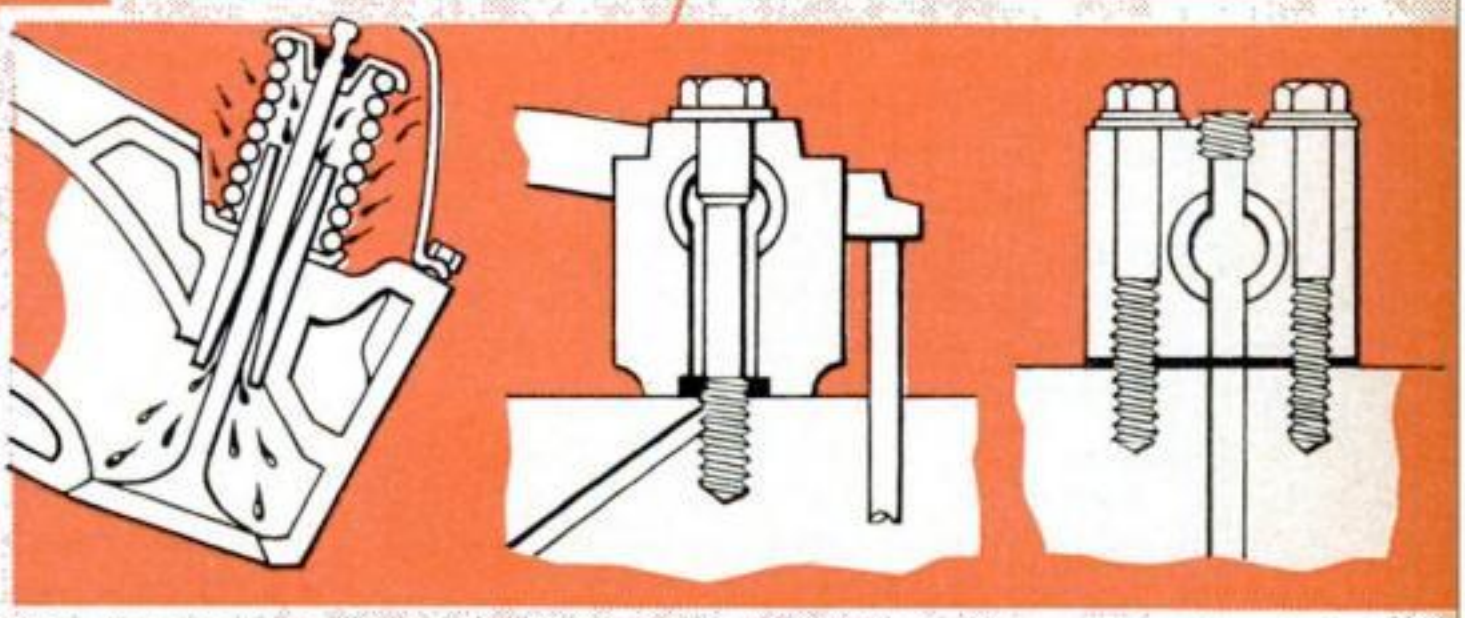


Spring pressure (above) pushes out piston ring to seal against cylinder walls, while gas pressure of power stroke pushes ring down against bottom of piston groove to form a complete seal. At right: Sectioned V-8 shows many gasketed joints plus vacuum-booster pump (1) and valve guides (2) where oil may leak out or enter combustion chamber.





Upper section of duplex fuel pump is vacuum-booster pump. Vacuum-inlet hose (A) can suck oil through perforated diaphragm (B), which is pumped up and down by lever working off camshaft and so has oil on one side and vacuum with a pipe to the intake manifold on the other. This is one of the cheapest and easiest-to-fix causes of excessive oil burning—install a new or rebuilt pump.

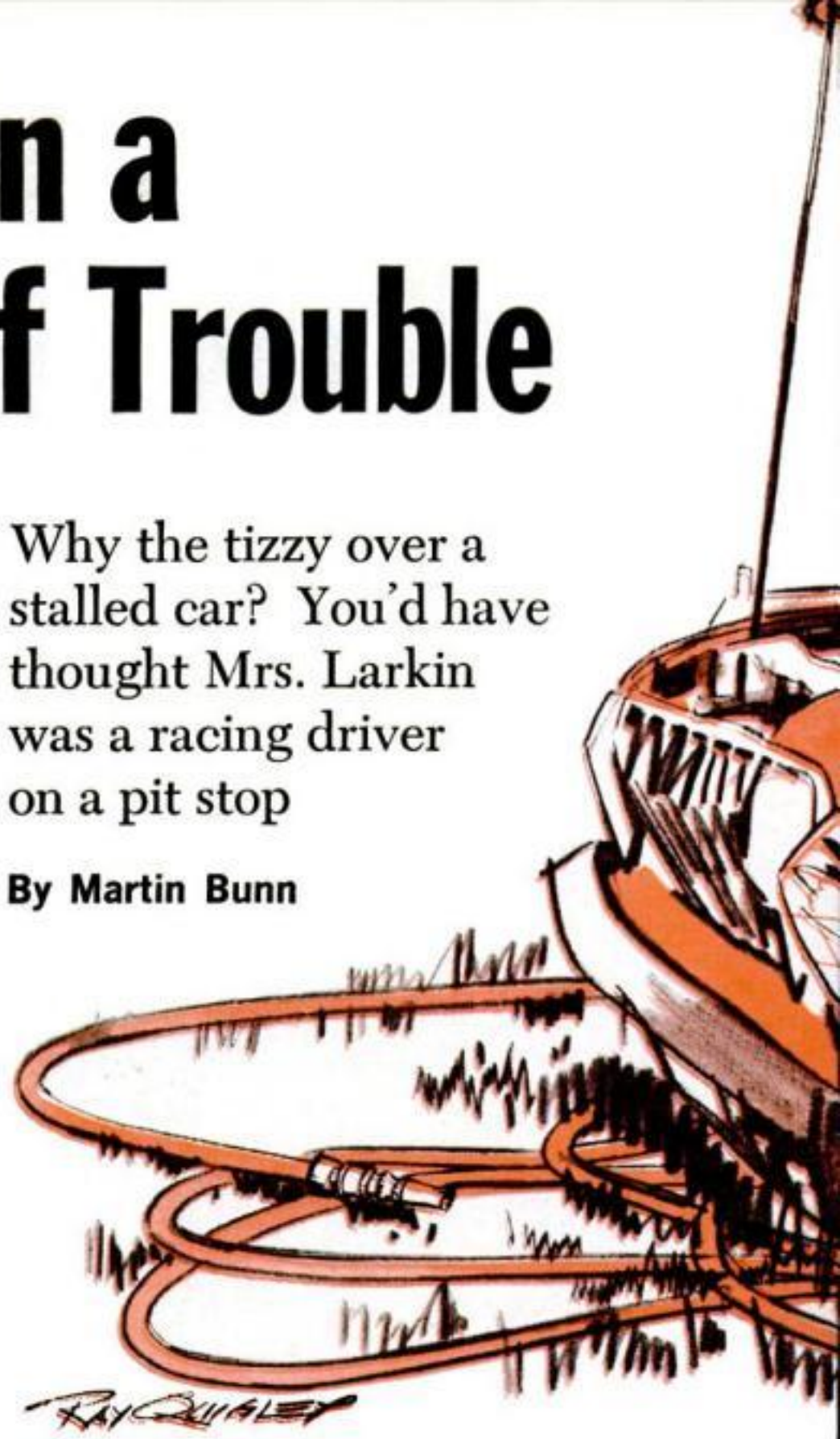


Worn intake and exhaust valve guides (left) are a common cause of excessive oil burning. If the engine is otherwise healthy, the cure may be about $10 worth of valve-stem oil seals, which probably can be installed without removing cylinder heads. One way to test valve guides as a source of burned oil is to cut off the oil supply. Some engines can have oilway past rocker-stand stud (center) stopped temporarily by a rubber O ring. More common open oilway through head and rocker stand (right) can be blocked by a shim under rocker stand. It's safe to run the engine for as long as an hour like this. If this stops oil burning, you know the cause.

Gus Takes On a Tankful of Trouble

Why the tizzy over a stalled car? You'd have thought Mrs. Larkin was a racing driver on a pit stop

By Martin Bunn



"IT'S really desperately urgent," said the feminine voice on the phone. "It won't even *start*. Could you come right away?"

"I'll come," promised Gus Wilson, and went out into the Model Garage shop.

"I have a service call, Stan," he told his helper. "You mind the store."

Making certain he had a booster battery and a can of gas aboard the truck, Gus got in and headed out of town for the newest subdivision.

Ten minutes later he rolled to a stop behind a small sedan standing in a carport. In the driveway of the house next door, a man was hunched over the engine of a Chevrolet hardtop. A woman opened a side door adjoining the carport, greeted Gus, and pointed unhappily to the sedan. "Please hurry, Mr. Wilson," she said.

The sedan's keys were in the ignition lock. Gus opened the hood, made sure that the choke and fast-idle cam were in normal cold-start positions, and tried the starter.

It ground away briskly. The engine's only response was a single half-hearted snort. Noting that the fuel gauge read over a third full, Gus got out but left the ignition on. He pulled off a cable, held it near the plug terminal, and triggered the starter solenoid by hand. Bright sparks snapped over, as regular as drum beats. Gus turned off the ignition and began to remove the air cleaner.

The side door opened again and the woman came out—a small brunette in her forties, dressed for town.

"I hope it won't take long," she said. "I'm due at a citizens' meeting on urban renewal right after lunch. Meanwhile, I'll pop in on a neighbor."

"One thing, Mrs. Larkin. Is that gas gauge right?" asked Gus.

"Oh, yes. I've never had the least bit of trouble with it."

Gus looked down at the boy and grinned. "Oh, you can give me about 10 gallons," he said.

Removing the air cleaner, Gus looked down the carburetor throat as he pumped the throttle by hand. Fluid gushed visibly from the accelerating jet.

"How many, mister?" asked a treble voice in the region of Gus's waist.

He looked down into the pixie face of a small boy, perhaps five years old, with a freckled nose and brick-red hair.

"How many what?" asked Gus.

"Gallons! We're playin' gas station."

Gus grinned. "Oh, you can give me about 10 gallons," he said.

"Okay," said the lad with businesslike curtness, and scampered off. Despite all the fancy new toys around, mused Gus, kids still invent their own fun on the run.

Urheberrechtlich geschütztes Material

Replacing the air filter, he shook his head. With a spark at the plugs and fuel in the carburetor, the engine should show more life than it had. Barring something drastic, like a stripped timing gear . . .

"Wait!" protested a childish voice. "You gotta take off the lid first."

Another voice answered. Still pondering his no-start problem, Gus glanced toward the kids—and almost tripped over himself getting into action.

A chubby, round-faced lad was triumphantly holding up the gas cap of Gus's truck, while the redhead was maneuvering the nozzle of a garden hose into the tank.

Gus grabbed it in time to deflect the pistol-grip spray head. Struggling in frustration, the redhead squeezed the handle. A mushroom spray hissed out. The other boy squealed as he caught the edge of it, and Gus snatched the filler cap from him as he scooted off.

"You said 10 gallons!" muttered the redhead, releasing the trigger at last.

"My tank's full," answered Gus. "Besides, this isn't my brand."

"But you said 10 gallons!"

"I made a mistake," confessed Gus, a suspicion growing in his mind. "Now Mrs. Larkin's car there won't start. I wonder if *it's* out of gas?"

The boy shook his head violently.

"How do you know it isn't?" asked Gus.

"Because I put some in right after breakfast," was the reply.

Gus drew a deep breath. "You've been

CONTINUED

Urheberrechtlich geschütztes Material

a big help, son. Now I know how to fix it."

"My pop fixes cars, too," said the boy, pointing next door. "He's Mr. Bennett."

"Then he can help me. Let's go over," said Gus, replacing the gas cap.

Hand in hand, with Gus carrying the hose, the two approached the hardtop. A young man with anxious eyes and hair that matched his son's greeted them.

"Hello. This fellow bothering you?"

"He was going to put gas in my truck," answered Gus with a grin, "from that fancy nozzle on your yard hose, which he'd already used on Mrs. Larkin's car."

"Ohforgoshsakes!" blurted the young father, looking even more harassed. "I'll give him what-for later; now, I've got to finish putting in new points. Sure picked the wrong day for the job. My wife's started labor pains—I may have to rush her to the hospital any minute."

"Could I look in your garage for an empty can or two to drain the tank?"

"Sure thing. Timmy will show you."

He bent over the motor again as Timmy led Gus to the garage. There was an empty antifreeze can and a big oil can. Returning with them to Mrs. Larkin's car, Gus got down and slid under the gas tank.

It had no drain plug.

Crawling out, Gus thrust a siphon tube into the filler neck. It encountered a bend or baffle a few inches down and would go no farther. After fruitless maneuvering, Gus gave it up and crawled under again to examine the tank mountings. Rusted, hard-to-reach bolts promised to make removing the tank a long job.

"What, for goodness sake, are you doing down *there?*" demanded a tense voice.

Gus crawled out to face a tense, harried-looking Mrs. Larkin.

"Well!" she exploded when he explained the trouble. "Stop shilly-shallying. Empty it and put in new gas. And *hurry.*"

The house door slammed behind her. Gus emptied and replaced the carburetor bowl. He removed and dried the wet plugs. Then he set the can of gas from the wrecker on a padded fender. Detaching the fuel line at the carburetor, he ran a piece of tubing from the petcock on the can to the carburetor, slipped an extension hose on the fuel pump and led it to an empty can.

The engine started on the second turn, its fuel pump sucking watered gas from the tank into the empty can. Gus opened the throttle a bit further. When the can was full, he substituted the other empty one.

The pump sucked dry at last. Gus put some fresh gas and a can of drier into the tank and emptied that also. Then he poured in a few gallons of gas. The Chevrolet next door backfired, but it was Mrs. Larkin's voice, taut with tension, that made Gus jump as he reconnected the line.

"Aren't you through yet?" she inquired.

Gus nodded, and started up the car.

"Here!" she said imperiously. "I'll get my change later. Just get that—that truck thing of yours—out of my way. Some things just *can't* wait."

Wondering how urban renewal could be in that much of a hurry, Gus backed the truck. As he hit the street, the young man pounded toward him, shouting.

"Need help! It won't run right. My wife . . ."

Gus parked the wrecker and followed Bennett, who got into the hardtop. The engine caught sluggishly, not at all eager to run. The exhaust burbled like a motor boat's. From the corner of an eye, Gus saw Mrs. Larkin's car back out briskly.

"Quits dead if I put it in gear," said Bennett. "I just put in new plugs, points, distributor cap, and rotor. Never would have if my wife had warned me how close she was. She says I get too excited."

Once more Gus wrapped a cloth on his

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Italian coupe has low-slung cockpit

This Fiat-Abarth two-seat convertible was styled by Pininfarina. Based on a Fiat 850 chassis, it has a rear-mounted engine enlarged to 60 cu. in. and tuned to 54 hp. for 95-m.p.h. top speed.

The low cockpit has a wraparound windshield curved to meet wide windows. A hinged steering column, iodine-vapor headlights, light-alloy wheels, headrests, and bucket seats are included.

Urheberrechtlich geschütztes Material

The 1955 Chevrolet V8 revised everyone's idea of what a production engine can do. Here we go again, Charlie.

TURBO-JET 396 V8

Every once in a while, in engine design, something special happens.

Technological advancement, and pure research, and engineering skill all happen to reach the same peak at the same time. The result is an engine that stands head-and-shoulders above all the rest.

That's what happened with the Chevrolet 265-cubic-inch V8 of 1955, which became the 283 and the 327. Everyone knows about those engines.

And that's what happened with this one. The official name is Turbo-Jet 396 V8.

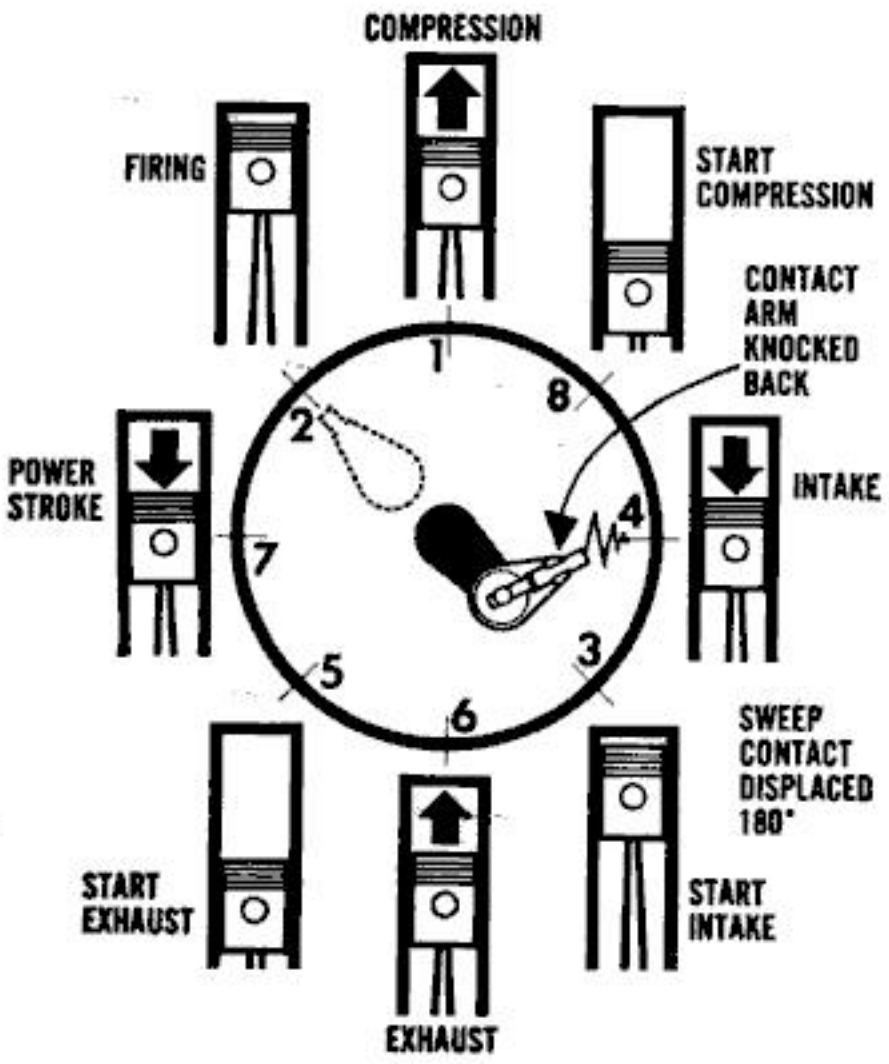
A new generation of engines begins right here.

396 cubic inches. 4.094 x 3.76 bore and stroke. 325 bhp at 4800 rpm, with 410 lb-ft of torque at 3200 rpm. From hydraulic valve lifters and one 4-bbl. carburetor. There's also a 425-horsepower version. (That's 1.073 hp per cubic inch.) Either is available in any Impala model.

Just try one, and see how we've understated the case. Chevrolet Division of General Motors, Detroit, Michigan.

CHEVROLET

Urheberrechtlich geschütztes Material



Mounted backwards, the distributor rotor was damaged but still functioning. When it should have fired number-two cylinder, it fired number four, where the piston was halfway down the intake stroke. If the sweep had been displaced a full 180 degrees and the rotor had fired number-three cylinder, then starting its intake stroke, the engine would probably not have run at all.

hand and pulled off a plug cable. A good spark jumped from it to the terminal.

"I gapped all the plugs right," insisted Bennett. "Points, too—there's the dwell meter I borrowed."

Gus nodded. The *put-put* exhaust suggested a compression loss—or mistiming. He followed each plug cable to its distributor tower. The firing order was correct.

"Ever have any sticking valves?"

Bennett shook his head. Gus scratched a mark on the distributor casing, loosened it, and gingerly advanced the timing. The result was a loud pop in the carburetor. Bennett jumped. Gus hastily retarded the timing. The engine faltered and almost died. He put it back on the marked setting and hooked up the dwell meter. It showed a correct 30-degree dwell.

Stopping the engine, Gus unsnapped the distributor cover. At sight of the big, flat rotor, he drew a breath of surprise. The brass sweep arm, which normally lay between two molded bosses, had broken one boss and was twisted aside. The whole rotor was cocked at a slight angle.

"Hey! What happened?" asked Bennett.

"You're not the first to put one of these rotors on backwards," said Gus. Loosening two screws, he lifted the big rotor and turned it over. "This little round projection and that square one fit into matching holes in the plate. But you got the round one in the square hole. It dropped in, but the square one sat on top of the round hole."

Without a word, Bennett rushed off and rummaged in a trash barrel. Gus maneuvered the distributor weights about and fished out four bits of the shattered boss.

Bennett came back with the old rotor. "Looks okay," pronounced Gus. He set it on properly and tightened the screws. Two of the cap contacts were scarred, but the plastic wasn't cracked. Gus snapped the cap back on. The engine started easily, with none of the previous exhaust static.

"With new points, the timing should be checked," said Gus. "But it'll do now."

The young man sighed with relief. "Sure was lucky you were around. I don't see how the engine ran at all, with the timing off by 180 degrees."

"The rotor was off 180," explained Gus. "But timing was one full crankshaft turn out—remember the distributor is geared one to two. That should have fired the plugs at the start of the intake stroke, and the engine probably wouldn't have run.

"But with the rotor cocked up on one side, that sweep contact hit on its first turn and was knocked back about an eighth of a turn. Instead of firing the fourth cylinder ahead, it sparked the third, in which the piston was halfway down on the intake stroke, and the valve almost closed. The engine ran—but only just."

Bennett nodded, then jumped as if stung. "Got to see about my wife!"

Gus was headed for his truck when a frantic hand spun him around.

"She isn't there! Nowhere in the house. Where could she go, in her condition? That Larkin woman was here. I'll ask her—"

"Hold it," said Gus. "She drove off—in a hurry. Try phoning the hospital."

Bennett rushed indoors. Gus was writing out his bill when the young man reappeared, a happy glaze in his eyes.

"It's a girl! She had Mrs. Larkin take her—thought I'd be too nervous. Got there just in time. How come you knew?"

Gus chuckled. "I didn't think Mrs. Larkin could get all that excited about urban renewal. Seems she had another kind of renewal in mind." ■■

Urheberrecht ch geschützt Material

"Get the message your plugs give you"

says Parnelli Jones, 1963 Indianapolis winner

Every time you pull the spark plugs from your engine, look 'em over. They can tell you a lot about the engine's condition.

If you find one or two plugs, say, fouled by wet, sludgy deposits, suspect worn rings or pistons or too much clearance between valve stems and guides for those cylinders. Worn or loose bearings are another possibility. Burned or overheated plugs—with white, burned or blistered noses and eroded electrodes—generally indicate inefficient engine cooling, overheating due to wrong ignition timing or a need for "colder" plugs. If just a couple show that condition, however, the trouble might be as simple as loose plugs!

It's mighty important to tighten plugs properly. Do it with a torque wrench. Here's a table that shows the amount of torque for different plugs:

Plug Hex. Size	Thread Size	Correct torque in foot-pounds	
		Cast iron heads	Aluminum heads
5/8"	10MM	15	10
13/16"	14MM	30	25
7/8"*	18MM	40	35
15/16"	7/8"-18	45	40

*13/16" with tapered seat—torque to 15 to 20 ft.-lbs.

In a pinch, use a ratchet wrench with short handle and tighten each plug about ¾ of a turn after plug begins to compress the gasket.

It's mighty important to use high-quality plugs, too. I like Autolites. Autolite heat-seals every plug it makes, fusing the center electrode to the insulator under tremendous heat and pressure to prevent compression leakage. Nearly everyone does this with racing and aircraft plugs. But not everyone does it with regular passenger-car plugs. Autolite thinks the extra protection is worth it. I think so, too.

AUTOLITE SPARK PLUGS

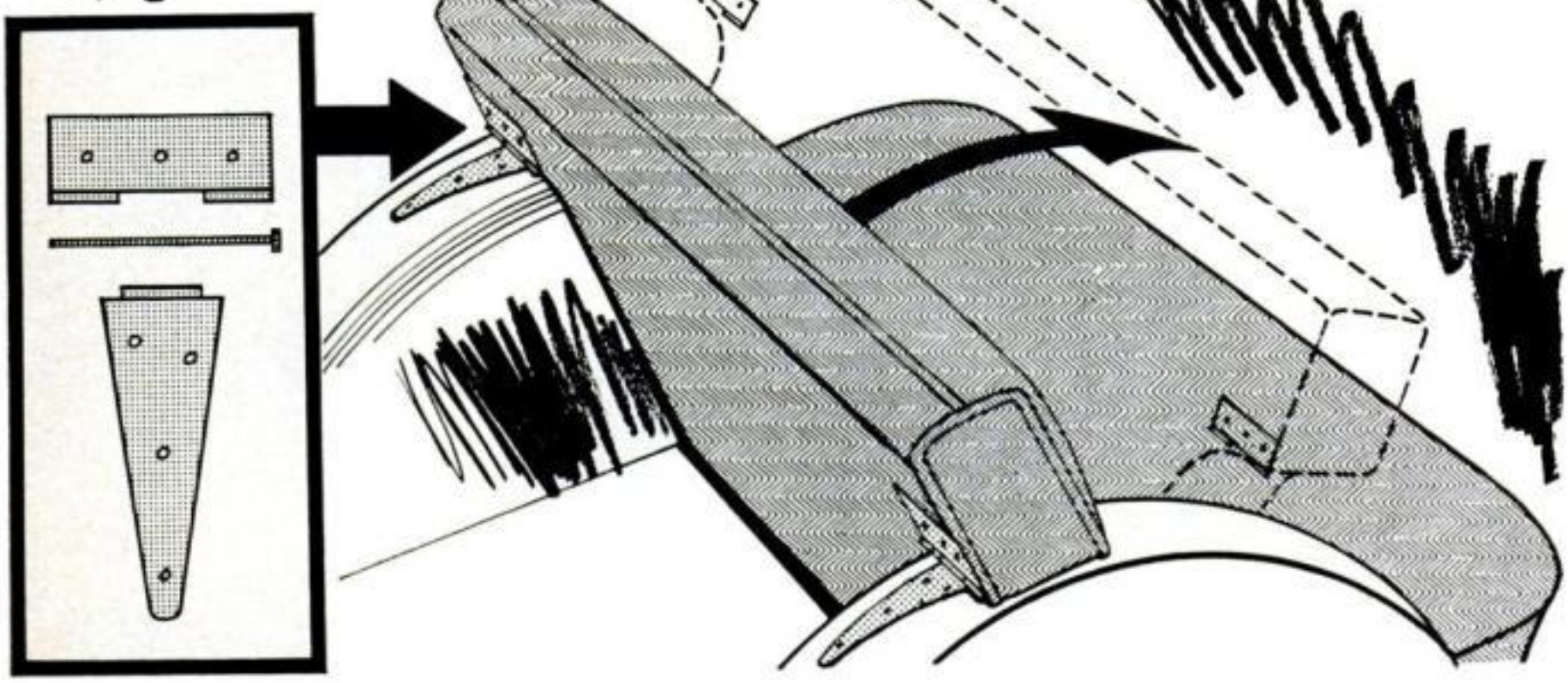
PRODUCTS OF Ford MOTOR COMPANY

RIDE WALT DISNEY'S MAGIC SKYWAY AT THE FORD MOTOR COMPANY PAVILION, NEW YORK WORLD'S FAIR

HERE ARE SOME OF PARNELLI JONES' RACING ACCOMPLISHMENTS: Indianapolis 500—Winner, 1963; top qualifier, 1963, 1962; Pikes Peak—Stock Division champion, 1964, 1963; Milwaukee—Seven stock car wins and a USAC 200-mile championship victory in past two years!; Trenton—Winner, USAC 200-miler, 1964; Riverside—Winner 200-mile Sports Car Grand Prix, 1964 (his 1st sports car race!).

Urheberrechtlich geschütztes Material

Hints from the Model Garage



Securing the side latches on the second-seat folding backrest is a matter of concern to many station-wagon owners. During hard braking, heavy loads pushing on the backrest may force the standard latch to give so that the second seat collapses. To accommodate long objects, it must still be possible to fold the backrest. The solution: barn-door hinges, installed as shown. Pull out the pins, and you can fold the backrest forward; when the pins are in position, the seat is completely secure.

Most trouble lamps will roll if placed where they light up the spot where light is most needed. Stopping the rolling is easy: Just bore two holes in a metal strip 6" long and secure it to the lamp with a thin spring around the light guard.

When you drain your radiator, you may lose precious antifreeze because of the drain-cock position, which causes dripping and splattering. Save the fluid by making a diagonal cut in an old elbow water hose and draining through it into a bucket.

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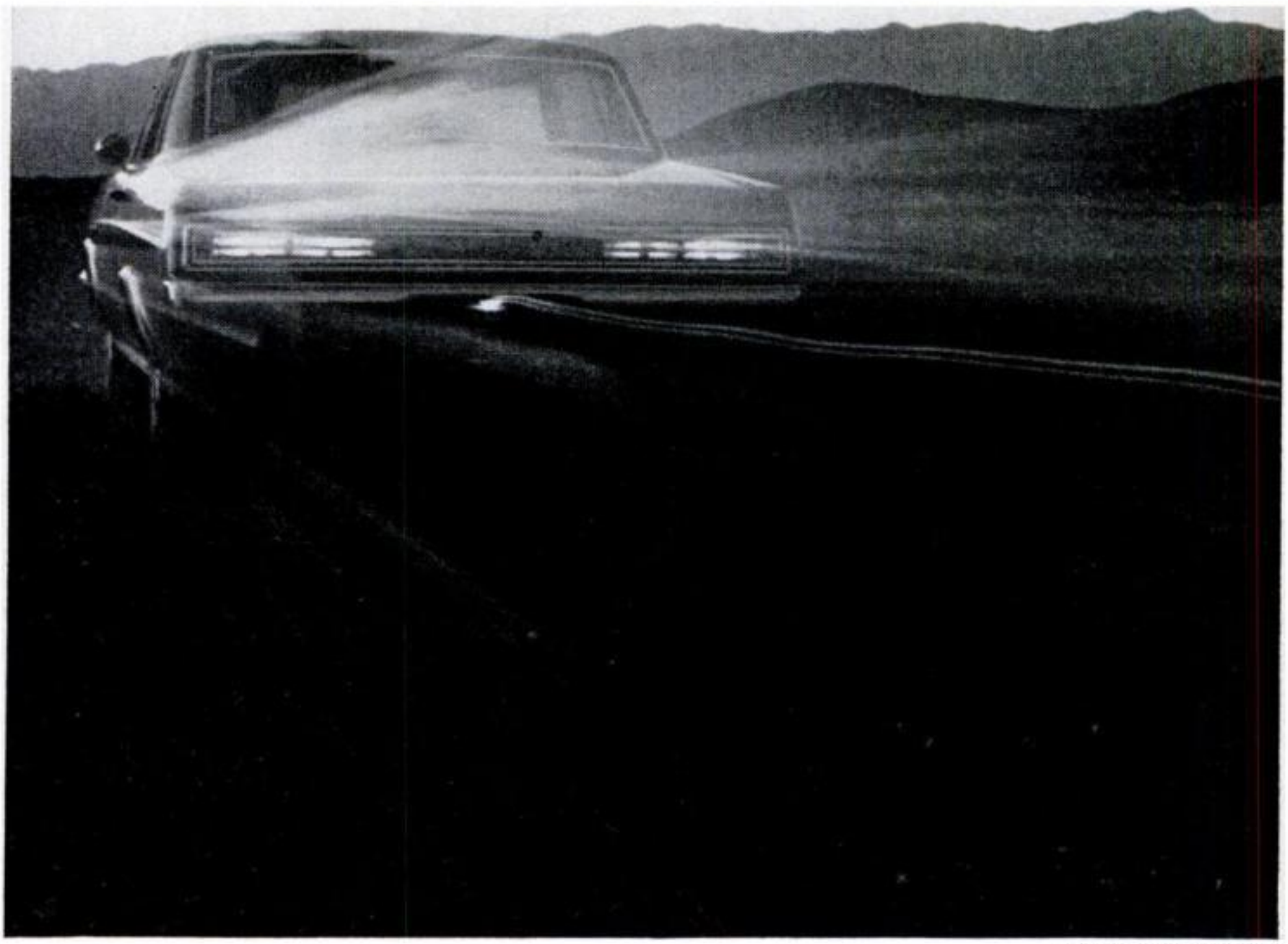
Urheberrechtlich geschütztes Material



BUICK MOTOR DIVISION

Superbird.

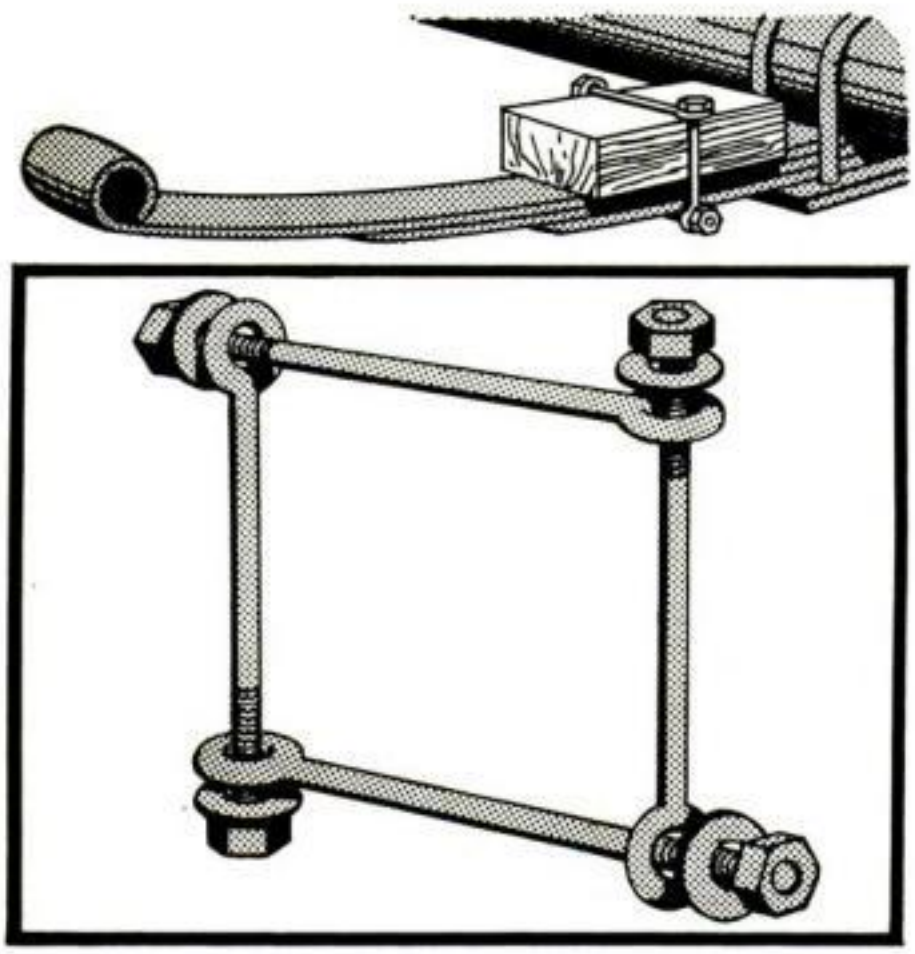
The Skylark Gran Sport.
400 cu. in. / 325 bhp.
Bucket seats.
Floor-shift, all-synchro 3 speed.
Heavy-duty suspension.
Oversized, 7.75 x 14 tires.
Performance axle ratios.
Zow!
The Buick Skylark
Gran Sport

Urheberrechtlich geschütztes Material

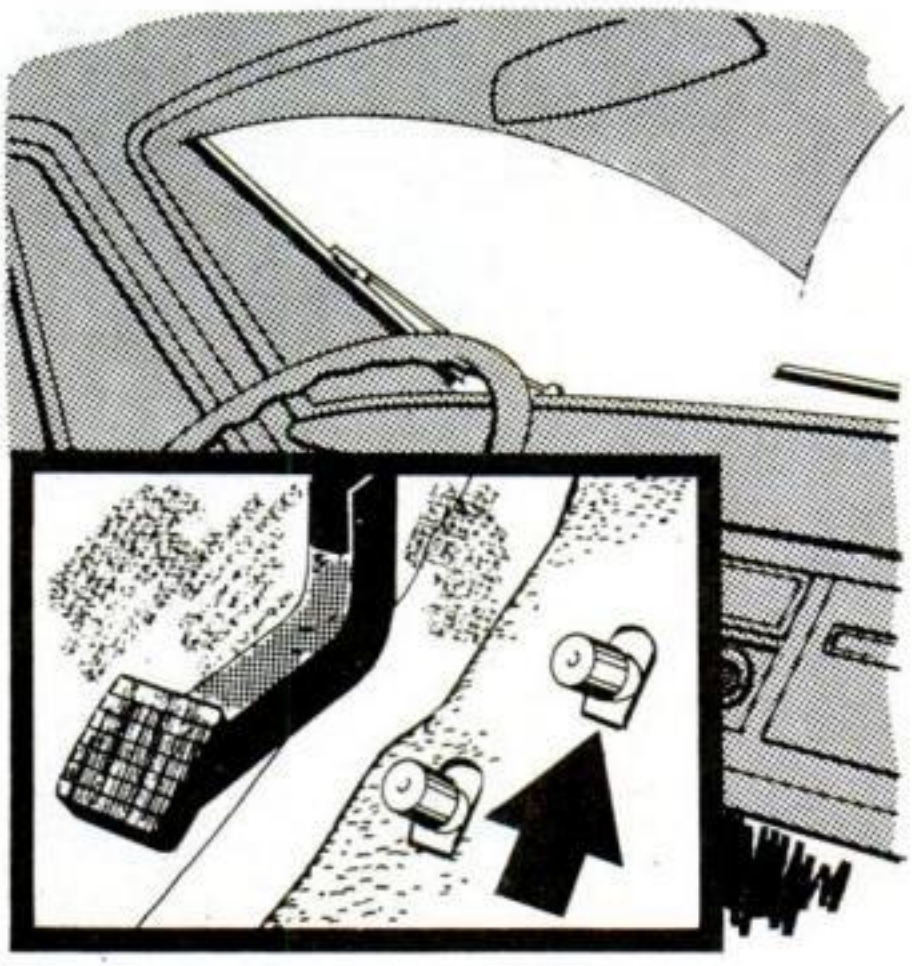
More Hints from the Model Garage

To check distributor points the fast way, insert a piece of paper stapled to a piece of carbon paper between the cam and the rubbing block. Turn the engine with the starter and check carbon imprint. If full contact is not shown, straighten the rocker arm.

Valve springs can be checked with a drill press and a bathroom scale. Lower the drill chuck on the spring, and compress to 50 pounds. Set the feed stop and compress all springs to the same point. Replace any spring showing more than a five-pound variation.



A makeshift repair of a broken main leaf needs only a 6″ length of two-by-four, four ⅜″-by-6″ eyebolts and nuts, four flat washers, and four lock washers. Jack up the car to ease the spring, fit the block of wood, and tighten the bolts as shown.



A foot switch for the windshield wipers is easy to make. Install a dimmer switch on the floor and connect it to the wiper motor and the wipers. This will enable you to keep your eyes on the road after a sudden splash instead of looking for the wiper knob.

Urheberrechtlich geschütztes Material

Get the smoothness of *two* front axles and a Six that feels like an Eight

You'll have to ride in this new Ford to believe that *any* pickup can ride so well.

For only Ford has *two* front axles. They work independently so that jolts at one wheel are never transmitted to the other. The front end doesn't "mush out" on curves. Doesn't dive when you brake.

On the road—or in the rough—you'll find Ford's Twin-I-Beam ride far smoother. And Ford's engines are smoother, too. Big, new seven-main-bearing Sixes feel as smooth as an Eight. A new 352-cu. in. V-8 is most powerful in Ford pickup history...economical, too. See your Ford dealer!

RIDE WALT DISNEY'S MAGIC SKYWAY AT THE FORD MOTOR COMPANY PAVILION, NEW YORK WORLD'S FAIR

'65 FORD

TWIN I BEAM
INDEPENDENT SUSPENSION

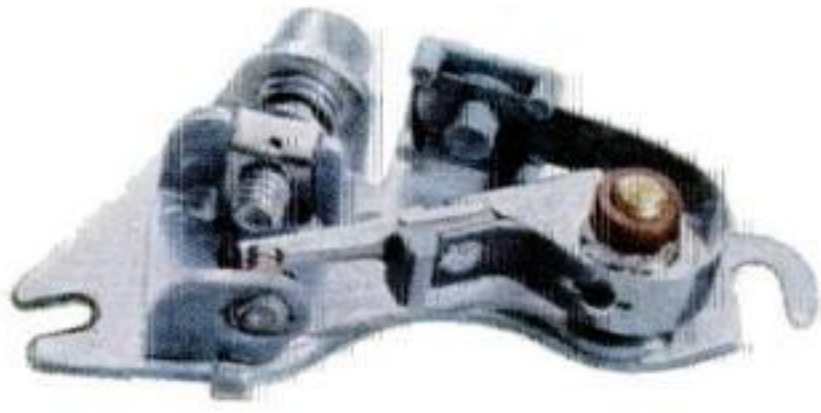
PICKUPS

BUILT TO LAST LONGER

Reason for Ford's smooth ride is exclusive new front suspension with *two* front axles. Each works independently so that shocks at one wheel are not transmitted to the other. Axles are forged I-beams as used in big-truck axles. Result: big-truck durability with car-like ride.

PRODUCTS OF Ford MOTOR COMPANY

Urheberrechtlich geschütztes Material



When your car needs a GM part like this . . .

make it a point to get the GM kind.

Why be so fussy? Well, for one thing, the ignition point set that came in your GM car was designed by its engineers to open and close up to 20,000 times a minute as it does its job.

And it was designed by your car's engineers to fit and work precisely with the *rest* of your car's ignition system, too.

So when it comes to getting a replacement set to do these important jobs—or *any* part that came with your GM car—you're not just being fussy when you insist on the genuine GM kind.

You're also being very smart.

And don't worry about whether your mechanic can get genuine GM parts. They're available just about everywhere in the country. You can recognize them by their distinctive GM and United Delco packages.

GENUINE GENERAL MOTORS PARTS

GM CHEVROLET • PONTIAC • OLDSMOBILE • BUICK • CADILLAC • GMC TRUCKS United Delco

Urheberrechtlich geschütztes Material

Stupid Highway Signs Can Kill

[Continued from page 108]

arrows painted on the pavement. As soon as the arrows appeared at entrances to California freeway exit ramps, arrests for wrong-way driving dropped by half.

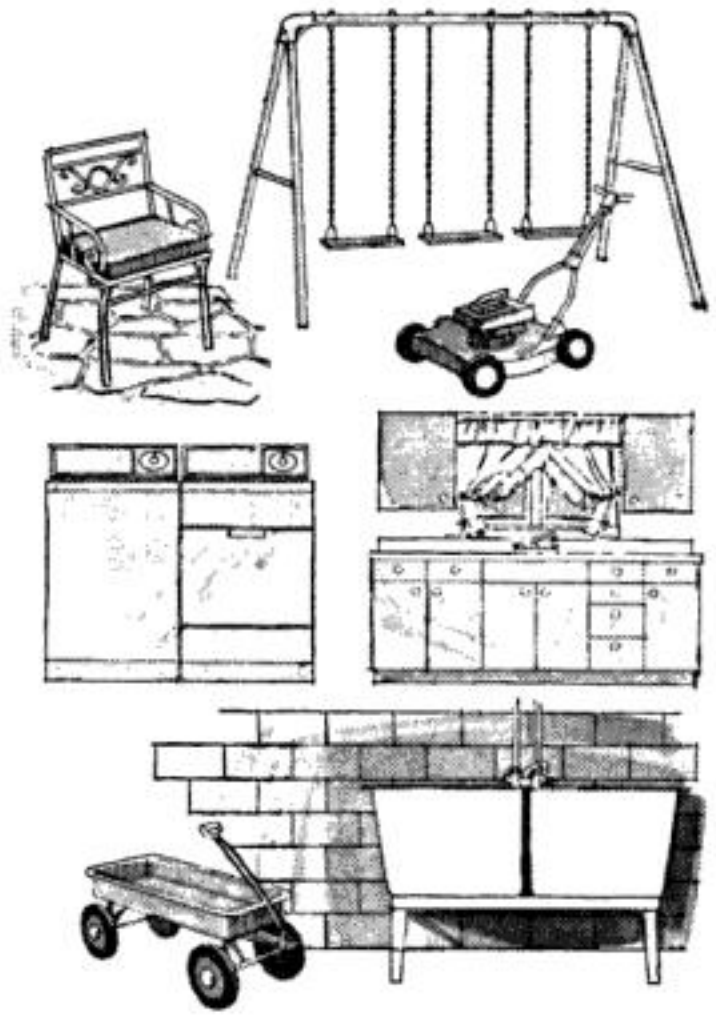
Next, Hulbert developed new red signs, with red flashing lights and loud horns triggered by a buried electronic sensor. These signs seemed to get more attention. Now California has ordered red "wrong way" signs installed at all of the nearly 5,000 freeway exit ramps in the state. Another idea now being tested is a reflective pavement arrangement of inconspicuous plastic wedges, visible only at night, that will pick up wrong-way headlight beams and point a red arrow at the erring vehicle.

The newest wrinkle in directionology is the "talking highway." Four 100-foot rumble strips—stretches of roughened pavement that make the tires hum loudly as you cross them—startle and alert you to a confusing turnoff ahead. In early trials at four California locations, the rumble strips actually cut accidents by half. Also on test are colored pavements—blue stripes for on-ramps, yellow stripes for off-ramps, black for lanes leading to exits.

Back to basics. If directionology has proved anything, it is that every sign ought to be pretested before it is placed on the highway. Now Hulbert and a mechanical-engineer associate, Charles Wojcik, have invented a gadget that does this testing quickly and cheaply. Their sign tester is a shallow oblong box about the size of a desk top, with a peephole and a steering wheel at one end. Sitting before the box, you grasp the wheel, put your eye to the peephole, and watch the unwinding of a roll of paper on which the highway lanes and ramps are drawn. You "drive" along the paper highway, reading the road signs. If you get lost, it proves the sign writer has goofed. Hulbert's tester is already on its way to eliminating bonehead road signs.

For those who write America's road signs, Hulbert has this key suggestion: "If what a sign says can possibly be misunderstood, it surely will be." In fact, Hulbert knows of only one sign in the entire nation that is a shining example of clarity. It stands in the Kings Canyon National Park in California, at the entrance to a road leading into the wilderness. The sign reads: "This is NOT the road to Fresno." ■ ■

Don't paint it...



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Urheberrechtlich geschütztes Material

A Cooling Waterfall or Fountain

[Continued from page 144]

Fountain jets vary widely in pump requirements because there are so many types. Some hurl huge mushroom-shaped sprays; others give only a single, pencil-thin jet. Some just bubble quietly, requiring very little water pressure. First pick a nozzle that will give you the shape of fountain you want; then pick a pump that will satisfy the nozzle's requirements for proper water pressure.

Pumps come in three basic types—those that work only under water, those that work only in open air, and those that work both in and out of water. In most cases, the submersible type is the simplest and cheapest to use, but be sure ahead of time it's what you want. A submersible-only pump can't be used out of water because it has no inlet connection. Water is drawn into it through many tiny holes in its base.

Good pumps have strainers or screens to keep out dirt and debris that might clog them. They should also have long cords for reaching to a distant outlet. Most pumps come with standard pipe-thread connections. Special fittings and adapters make it easy to attach nozzles or hoses as needed.

Planning your pool. For a waterfall, your pool, or catch basin, can be any size you want. It only has to be big enough to hold the recirculating pump.

A fountain pool is a different matter. Its diameter will depend on the size and height of the fountain. The taller a fountain, the more likely the spray will be blown sideways. If the pool below it is too small, the downspray may well miss the pool completely on a windy day.

A good working rule is to make the pool's diameter at least 1½ times the height of the fountain. A 4′-high fountain would thus require a 6′-diameter pool. If the fountain is very high or the prevailing winds unusually strong, this ratio can be increased.

The pool does not have to be deep, but it should at least cover the pump and any other equipment placed in it. Fountain jets and underwater lights may require more depth than a pool used only to hold a pump for a waterfall.

If you use black polyethylene film as a liner, it will tend to camouflage the pump and give the water an appearance of greater depth. The plastic can be painted, if you prefer, or can be bought in colors.

Get the heaviest gauge that's available, and use two layers for added strength. Polyethylene film comes in such wide pieces that there shouldn't be any need to worry about seams for a small pool. Just cut the plastic slightly larger than the hole all around and anchor the edges under stones or earth at the rim of the pool.

Where to buy the parts. Some of the makers of fountain and waterfall supplies are listed below, together with a brief description of the equipment they sell. Most of them can send you a complete catalogue and price list to help you make a selection.

Rain Jet Corp., 301 S. Flower St., Burbank, Calif. 91503 (has a wide range of equipment including fountains, pumps, jets, and lighting equipment). Pumps: $79.50-$129.50. Jet heads: $16.50-$40.

Garden House Products, 818 E. Broadway, San Gabriel, Calif. 91776: Submersible and open-air pumps, $16.83 to $69.38. A kit for $21.85 includes pump, screen, 10′ plastic pipe or hose, and flow-control valve.

Zeno Plastics Co., 17117 S. Figueroa, Gardena, Calif: A kit for $18.95 includes pump, 8′ plastic hose, 7′ plastic liner for pool, pump filter, and complete instructions for building a cascade with rocks. Also fountains and cascades with sets of four bowls, $69 to $80.49; three bowls, $33.90 and $36.65.

Little Giant Pump Co., 3810 N. Tulsa St., Oklahoma City: Waterfall kit with 300-g.p.h. pump and directions for building waterfall or cascade with rocks. Included at $34.95 are: pump, two 6″ pipe nipples and couplings, adjustable spray head, 8′-by-8′ plastic pool liner. Other kits available from $25.75 to $64.95. Also individual pumps of submersible type or for open-air service, or both, from about $16 to $60.

Van Ness Water Gardens, 2460 N. Euclid Crescent West, Upland, Calif. 91786: Little Giant pumps and some fountain heads for jets.

Other sources for fountain equipment are: Erkins Studios, 10 W. 40th St., NYC 10018; Florentine Craftsmen Inc., 479 First Ave., NYC 10016; Canal Electric Motor Inc., 310 Canal St., NYC 10013; William Tricker, Inc., Independence, Ohio, and Saddle River, N.J.; S. Scherer & Sons, Waterside Ave., Northport, N.Y.; Three Springs Fisheries, Lilypons, Md.; Bello-Groppi Studio, 421 Wisconsin Ave., Chicago 14. ■■

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All eleven Western Wood designs are in our new "Vacation-Land Homes" booklet. You can buy a copy from your lumber dealer now, for a dime. It's really a bargain. There's a complete description, architectural rendering and floor plan of each vacation home. And there's a list of all the materials necessary to build any one of the eleven designs. After you pick the design best for your site and family, we'll provide you with detailed construction plans for just $5.00. For each of these novel second home hideaways, the architects have specified Western Woods. For good reason, too. Western Woods not only fit the rustic mood of the great outdoors, they're easy to work, easy to saw, easy to nail, and they take any kind of paint or stain.

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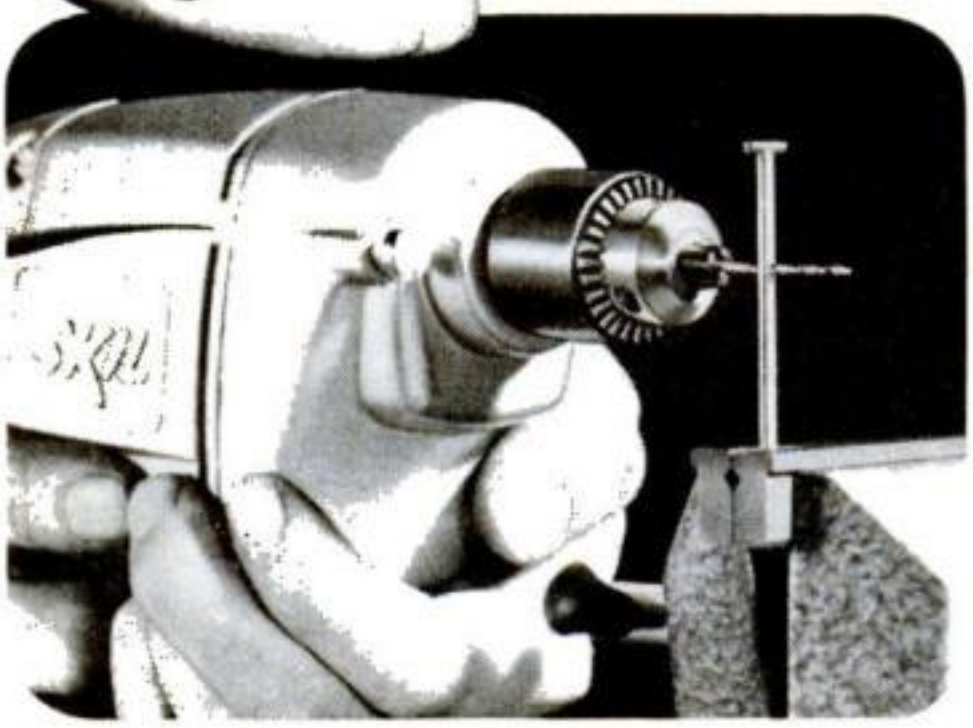
The green trigger identifies the greatest advance in electric drills in 50 years!

Exclusive! New! Skil



HOLE IN NAIL DEMONSTRATES THE AMAZING CONTROL OF NEW SKIL DRILL. We did it with the ¼" Skil Trigger Speed Control (TSC) Drill. TSC drills also available in ⅜" and ½" sizes.

A PRECISION DRIVER, TOO! With the versatile Skil Trigger Speed Control Drill the variable speed feature lets you start screw at low speed, run it down at high speed, set it by slowing to a stop.

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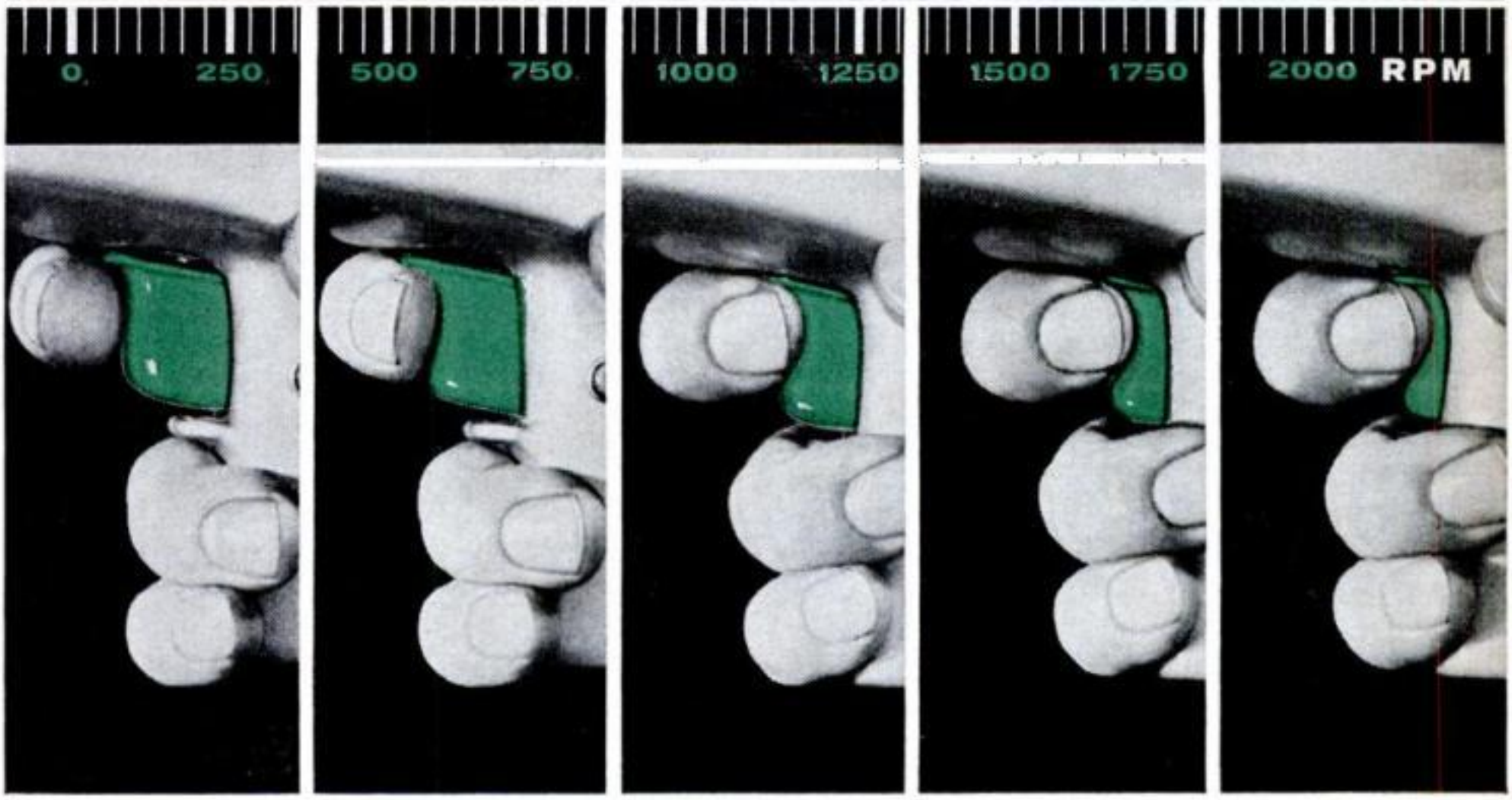
SQUEEZE THE DRILL SPEED YOU NEED

With Trigger Speed Control you actually sense the correct speed with your trigger finger—much as you sense your car's speed with your foot on the accelerator.



Trigger Speed Control Drill

For the first time, you regulate speeds, from 0 to 2,000 rpm's, with your trigger finger

TO MATCH THE MATERIAL

You get stepless speed control to drill plastics, composition materials, wood or metal by varying finger pressure. No buttons or dials to fool with.

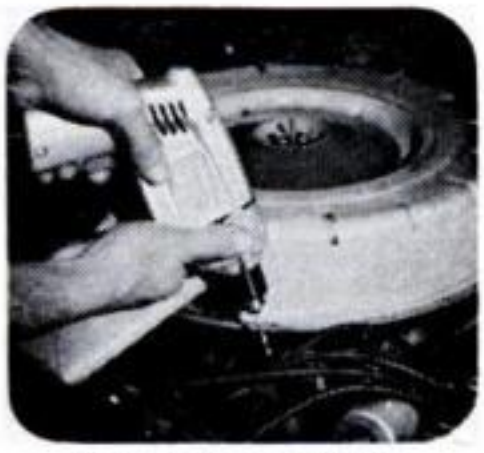
TO DRILL HOLES IN METAL WITHOUT CENTER PUNCHING

Start with light trigger pressure which keeps rpm low, makes bit placing easy—even on convex surfaces.

TO DRIVE SCREWS TO EXACT DEPTH

Exchange drill bit for driver bit, drive screws to exact depth you want. Even drive self-tapping metal screws—without center punching.

SEE NEW SKIL TSC DRILLS AT BETTER DEPARTMENT, HARDWARE AND LUMBER STORES EVERYWHERE



AUTOMOTIVE

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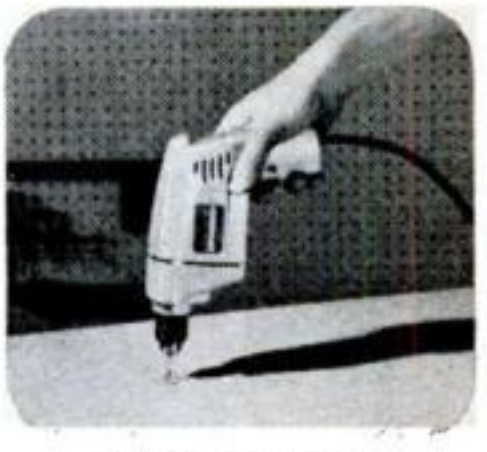

WORKSHOP

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REO RELIABLES
—the powerful performers

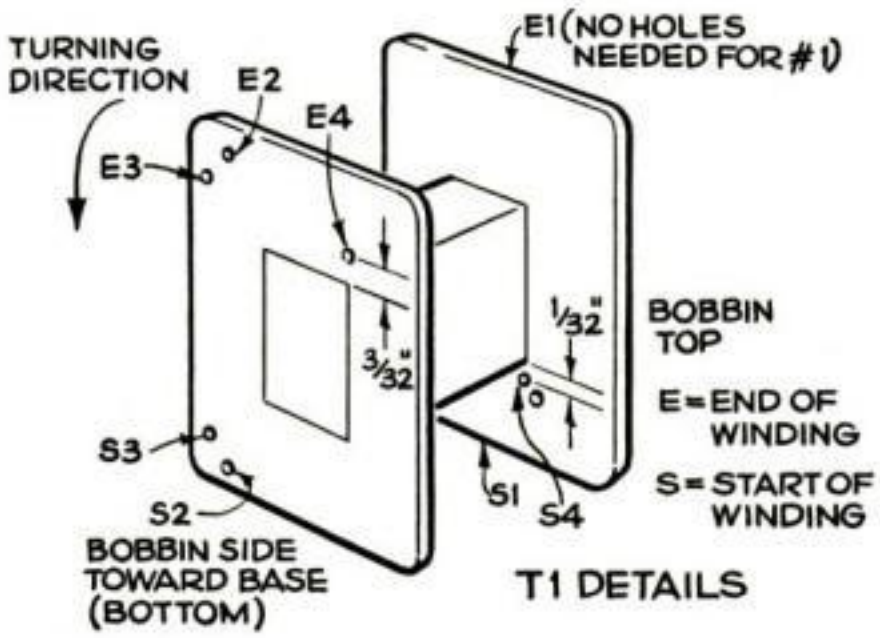
REO by Wheel Horse

Build a Capacitor-Discharge Ignition System

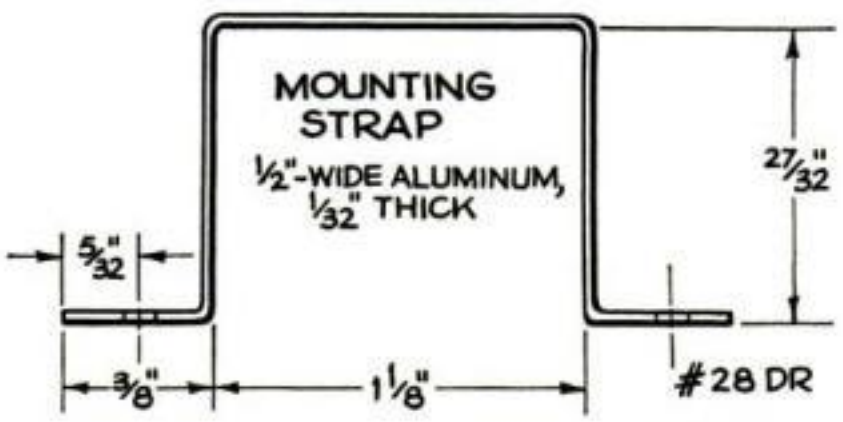
[Continued from page 96]

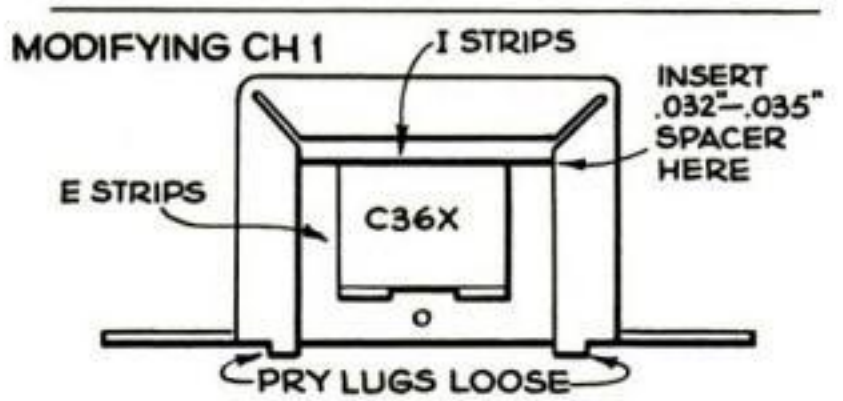
Mount transistors Q1 and Q2 in heat sinks (see parts list).

Mount the finished chassis in an aluminum minibox; drill ventilation holes in the top and sides of the box. A junction box, consisting of a barrier-type terminal strip and female Jones plug mounted in a minibox, makes it easy to connect the chassis



T1 DETAILS





Transformer T1 is wound on a nylon bobbin. Drill holes for the leads as shown above. Its mounting clamp is a bent aluminum strip. Choke Ch1 is a modified commercial unit (see text).

to the engine. Also, a shorting plug lets you instantly switch back to the conventional ignition system in case the C-D unit fails.

Mount the completed chassis inside the engine compartment close to the distributor and ignition coil. Make sure it's well away from engine hot spots.

Hint: For best C.D. ignition performance, the engine must be timed and tuned according to the car maker's specifications. ■ ■

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Urheberrechtlich geschütztes Material

[Continued from page 164]

total of nine options, all different, offering three chuck capacities, six speeds, and a range of power from 2 to 4½ amps—quite a selection.

Yet the tools are so outwardly alike in many cases that you have to look at the nameplate to tell which is which. Inside, they're also similar in many ways. The economy models use the same high-quality machine-cut gears, castings, and other parts as the top-priced models. In some cases, even the motors and bearings are the same.

The difference lies mainly in how the motor in each tool is geared to do a particular job. For example, the premium ¼" drill, the premium ⅜" drill, and the economy ½" drill all have motors of essentially the same capacity. But they're geared to give three different speed and torque combinations from a fast-cutting 2,000 r.p.m. in the ¼-incher to a slow, bull-through-anything 650 r.p.m. in the ½-incher. In price, there's only $1 difference between the ½" and ⅜" models and $3 between the ⅜" and ¼" models. So obviously you don't make a choice based on cost. You pick the drill that will best handle the kind of work you do most.

There are minor differences, of course. The higher-priced models have longer cords and often an extra feature such as an auxiliary handle. To help make identification of the tools easier, the cords and nameplates are color-coded according to price class—red for economy, blue for custom, black and gold for premium.

Checking them out. We gave most of the new tools a tryout to see how they compare. The results are shown in the chart on the opening pages of this article. The ¼" and ⅜" drills were clocked to see how long they took to bore jumbo-size 1" holes in 2" stock. The ½" drills were timed making ½" holes in ⅛" mild steel. The sanders removed paint from test blocks (small blocks for the orbitals, larger ones for the belt jobs). The figures for circular saws are cutting times per foot in ¾" plywood. Those for saber saws are cutting times per foot, first in ¾" pine, then in ¾" plywood.

While these tests are obviously arbitrary and incomplete, they do help to give an idea of how different tools compare doing the same jobs. They turn up some surprises, too. You'll note that in several cases the middle-priced models did not perform much better than, or even as well as, their lower-priced cousins. One answer may be that most of the middle-grade models have been upped in speed without being upped greatly in power. They thus may be performing less efficiently than the slower but more-powerful-by-comparison economy models.

Whatever the reasons, our tests indicate that the so-called economy tools are fine buys in their price class—with one possible exception, the ($8) ¼" drill. This stuttered and stalled repeatedly and seemed minimal, even allowing for its modest price. Also, the handle location is poor on both the ¼" and ⅜" economy models. It's too far to the rear, giving the tools a nose-heavy feel. This is strange, considering that the custom models have identical housings but with the handle in the *right* place, nicely balanced.

On the plus side, one of the most pleasant surprises was the little $27 economy-grade ½" drill. Small and light—only 4½ pounds—it's a honey of a buy for the home shop that wants ½" capacity without the expense of a heavy-duty, industrial-type drill. Its speed of 650 r.p.m. is high enough to handle a broad range of drilling jobs. The $15 economy-grade saber saw also struck us as an extremely good buy.

The "best" are good, too. In most cases, the top models proved to be equally good buys in their own price class. What they offer mainly is greater capacity. The premium belt sander, for instance, takes a 4" belt. The cheaper models are 3" jobs. The premium-grade circular saw swings a 7½" blade against 7" on the cheaper models. All three, however, proved to be almost uniformly fast-cutting. The premium-grade orbital sander has more pad area than the other models and an excellent built-in vacuum dust collector.

The premium-grade ¼" drill turned in a whopping performance. My only quibble with it is that it's on the hefty side for a ¼-incher. It's as big as the small ½" drill.

The routers were not tested, but bear the marks of fine machinery. There are two models, a 23,000-r.p.m. one for about $50 and a 27,000-r.p.m. one for about $67. The horizontal-blade reciprocating saw, also not tested, sells for about $33.

Besides these portable tools, there are two twin-wheel bench grinders for $15 and $30. Penney also offers a full line of other stationary power tools—thus putting them in the tool business in a big way. ■ ■

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Here's all there is to know about this GMC pickup. Except for one small thing.

Husky wood floor is quiet and long lasting. None of that annoying drumming and rusting.

Strong. Quiet. Comfortable. Two walls of steel with a thick pad of insulation—not just one wall like some. Inside—adjustable seat back and foam seat.

No tangle of wires behind the instrument panel. In its place is a printed circuit. Only GMC has it.

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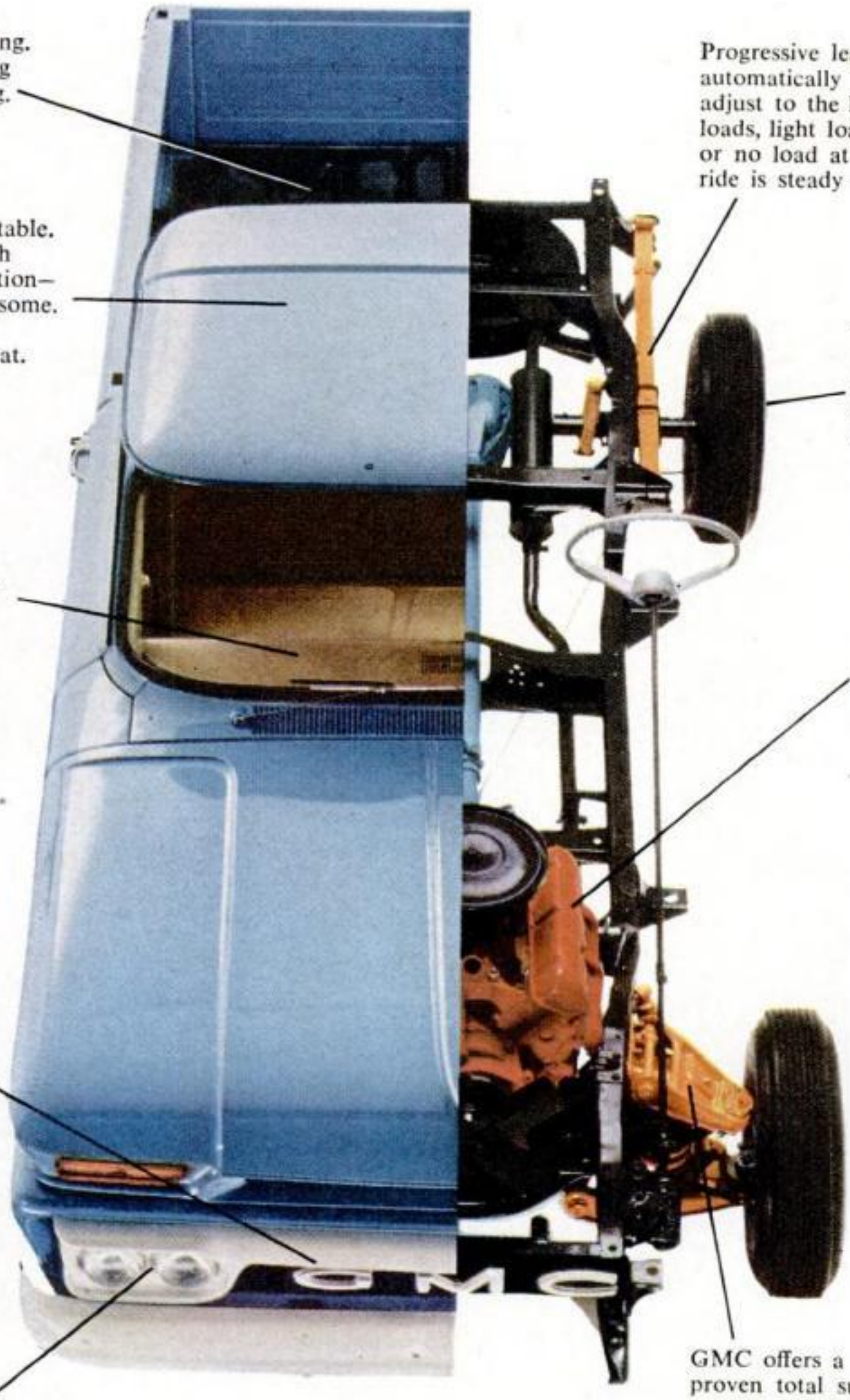
A GMC has four headlamps. Most other pickups have just two.



Progressive leaf rear springs automatically adjust to the load. Heavy loads, light loads or no load at all, the ride is steady and smooth.

Tires are king-size (8.15 x 15). Yet they're standard equipment on this GMC. Others charge extra.

The exclusive V-6 truck engine has gone 120,000, 130,000, even 150,000 miles before major overhaul. About half that is average. But the V-6 isn't just an average truck engine.

*Based on manufacturers' suggested retail prices, the GMC V-6 model pictured above is never priced more than $49 over comparable competitive base models. Often the difference is less.

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TRUCKS
FROM ½ TO 60 TONS

GMC offers a proven total suspension system of independent front and progressive leaf rear springs. Result? Always a smooth ride even with maximum loads.

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■ Fun-loving people rally here . . . bring a friend and all his gear — there's plenty of room in the Seasport. Besides generous floor areas, there are four cargo lockers (two with locks) plus eight-foot shelves. ■ How come all this big-boat room in a 17-footer? Because we designed new ways to make water behave under a boat — and to gain more usable room. ■ Full-rigged for comfort, too. Shock-absorbing seats you can re-arrange or take ashore, leaving a neat, snag-free floor — thanks to ingenious Johnson seat fasteners. Optional convertible top goes up almost as quickly as an umbrella. Drives like a car, with all operating functions at your fingertips. Levels with you, getting in or strutting the 'Johnson glide' in tight turns. Full-range performance with any of three Johnson stern drives. (This is one rec room that'll do 40 miles an hour!) ■ Your Johnson Boats dealer is probably polishing your Seasport's dual windshield now . . . that's about the only elbow grease required on this all-fun job. Catch him at it! ■

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Ships and Planes Navigated by Satellites

[Continued from page 77]

orbital data; computes the "fix"; and even types the results, in latitude and longitude, for the navigator.

On a production basis, the Navy estimates, the shipboard equipment could be built for about $12,000 a set. Thus, use of Transit satellites for navigation would be entirely within reach for commercial shipping. Since the system, as a Navy spokesman puts it, offers an "accurate, dependable, worldwide, all-weather, 24-hour-a-day passive navigational-fix capability," Transit should find a lot of takers.

For subs and aircraft, too. One of the hottest customers, of course, is the Polaris submarine fleet. For the effectiveness of these missile-launching subs depends on accurate all-weather position information, gained without betraying the ship's location by sending radio signals.

The Transit system seems equally suited for use by aircraft. Potential advantages are obvious for military or commercial planes, flying over oceans or large land masses without adequate (or cooperating) ground-based radio-navigation aids.

The navigation satellites weigh about 150 pounds, and thus require only modest boost power. For global capability they must be placed in polar or near-polar orbits, so that the spinning earth will expose its entire surface to the satellite. A series of suitably spaced satellites provides around-the-clock coverage.

Transit satellites have special features worthy of mention: They are "gravity-gradient stabilized," which means they apply the phenomenon that a dumbbell-shaped object placed in earth orbit tends to align itself in the direction of the earth's gravitational pull. Transit's transmitters are equipped with oscillators that stabilize the transmitted frequencies with an accuracy of one part in ten billion, for utmost precision in determining the Doppler shift.

The electronic equipment of two of the three Transit satellites is powered by an array of 18,000 solar cells. The third one uses a SNAP-9A nuclear-power source—an atomic battery in which heat from plutonium 238 is converted by thermocouples into about 20 watts of electricity. Both solar and nuclear power sources provide lifetimes far in excess of the Transit satellites' guaranteed two-year usefulness. ■■

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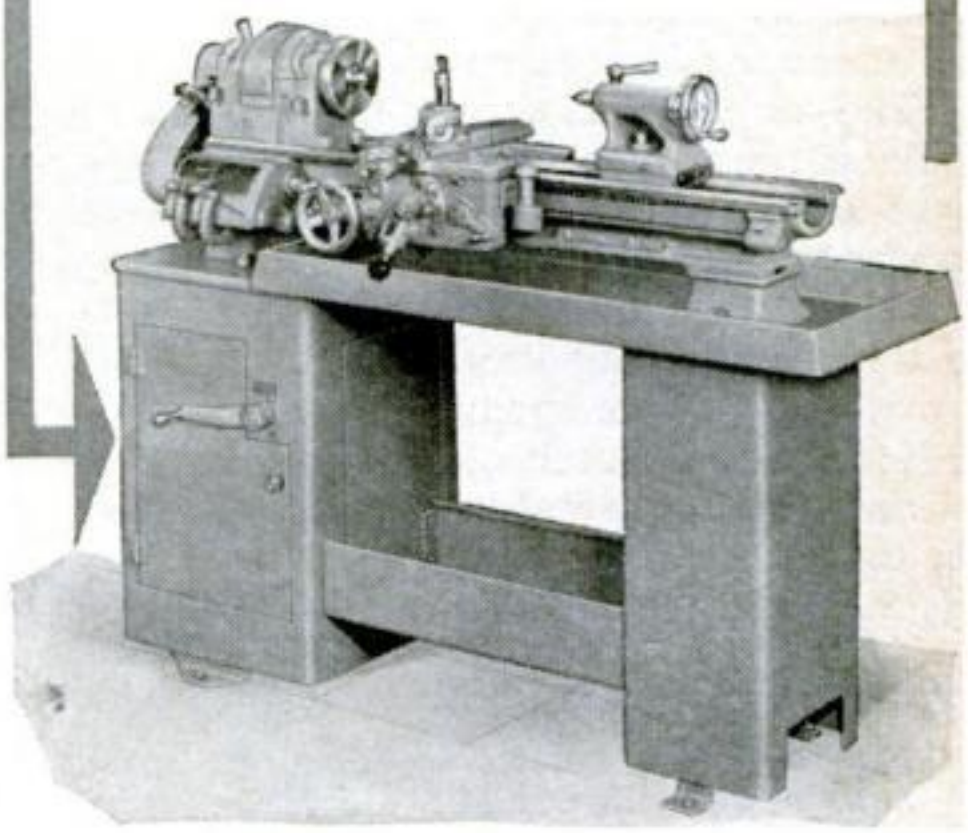

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[Continued from page 86]

representatives who interview each prospective student. These representatives earn their commissions partly by how you fare in your studies. This eliminates any temptation to load you up with courses you can't handle. You buy ICS course units one at a time. And nearly all ICS students pay on installment plans as they learn.

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Practicality and realism. These are stressed in the texts. They focus on problems you have to solve in actual work situations. For instance, in accounting, you have to balance a whole set of books—first for an individually owned business, then for a partnership, finally for a corporation. In keeping with the realistic instruction, current tax rates are used.

Popular Science and the International Correspondence Schools are conducting a search for famous ICS students. If you know of any famous ICS alumni, please write to the Editor, POPULAR SCIENCE, 355 Lexington Ave., NYC 10017.

You are tested at the end of each study unit. Essay tests are issued, calling for broad answers—worded so they're really teaching tools. You can't pass by merely copying a portion of the text.

When you mail in your test, it's routed to an instructor who is an expert in that course. The instructors usually mark papers fast enough for you to get yours back within a couple of days. They point out your errors, but you have to go back to the books to find the correct answers. Instructors show you possible short cuts and urge you to eliminate unnecessary work. Good students get little, if any, help, but anyone who needs it gets plenty of assistance. If necessary, long explanatory letters are written to help you over stumbling blocks.

Grading system. Your lessons are marked A, B, C, on a 100-point basis. A is 95 percent and a passing C is 75 percent. There's no failing grade. The worst mark is a W, meaning "withheld." Then you rework the unit until you pass—and you must before you go on to the next unit. Over 50 percent of its students request ICS to send their grades to their employers. This frequently pays off in salary hikes and promotions. The ICS method of study is similar, in many respects, to honors programs. You study at your own pace and are on your merit every step of the way.

ICS courses give you only what you want to study. Engineering courses don't branch out into the liberal arts. This conserves time for your main interests and also cuts your costs. ICS's most expensive course—in preparation for a state licensing examination in engineering—takes six to eight years to complete. Its cost—$1,100—is about what some colleges charge for a semester.

There are disadvantages, of course, to this straight-line learning. You get a broader education when you attend a resident school and take subjects not directly related to your main interests. But when time and money are limited, correspondence study is rewarding.

Just how rewarding? The school's surveys indicate that graduates' earnings increase an average of 31 to 35 percent five years after completion of courses.

Ten percent of the nation's land surveyors are ICS men. In Oregon, 38 percent of the state's highway engineers are ICS graduates. Ten percent of all U.S. engineers are also graduates of ICS courses, including many "hyphenated" engineers—those who have graduated from college with specialties in which they couldn't find jobs. Their solution: an ICS course to learn another phase of engineering where good jobs are available.

These results will become even more apparent during the next few years, because home study is responding to the challenge of rapidly increasing demand. This demand is from men who know that the only way to a good career is to acquire more knowledge and skill. And learning by mail is one of the most effective routes to a better future. ■ ■

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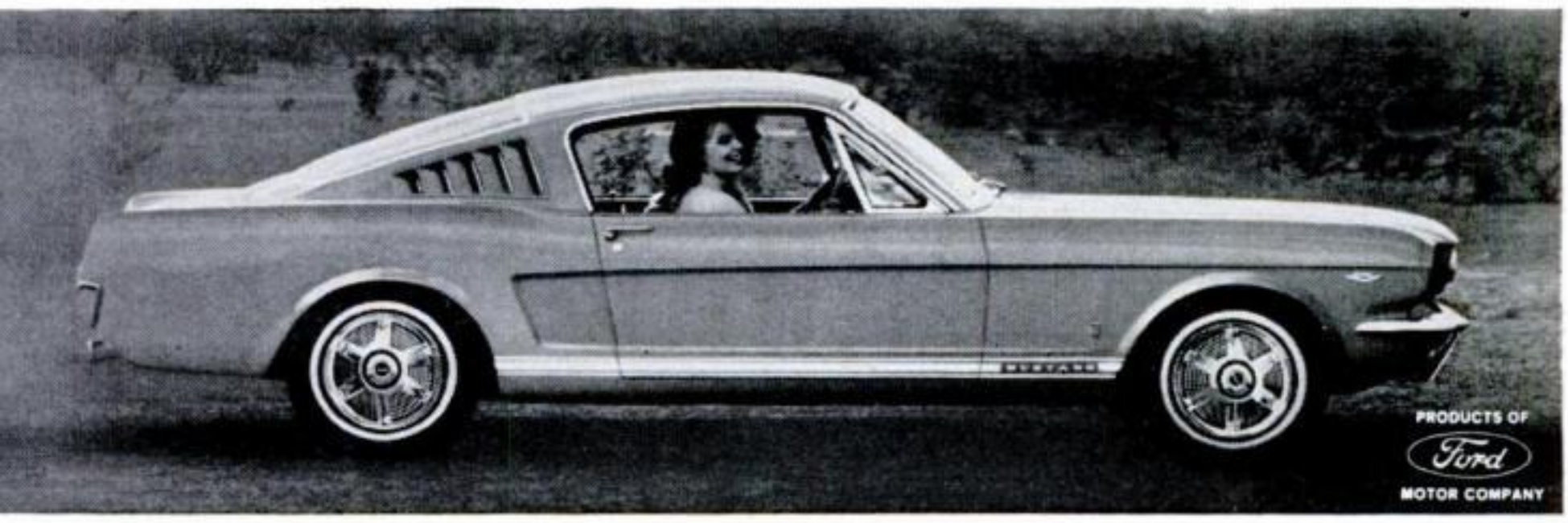
The ultimate total performance car— Ford GT!

Brakes clamped full on, the fabulous Ford GT slows for a corner in the Daytona 2000-kilometer endurance classic. In 12 hours and 27 minutes of savage punishment it out-braked, out-handled, out-sprinted Europe's and America's greatest entries. On the toughest proving ground of all it proved itself the world's ultimate road car.



The car it inspired— new Mustang GT!

Here's Mustang's brilliant new package for the driver who knows what Total Performance really ought to mean. Who else delivers exhilaration like this: a 225-horsepower V-8, fueled through a four-barrel carburetor. A three-speed fully synchronized floor shift. A straight-through exhaust system. Front disc brakes. Built-in fog lamps. The cornering power of Mustang's special handling package. GT insignia on the front fenders and the new symbol of Total Performance—the GT stripe—above the rocker panels. And, inside, a custom GT five-dial instrument cluster.

That's the basic GT package. But for even lustier appetites, there's a super-option—Mustang's 271-horsepower solid lifter V-8 and the four-speed manual shift. Both packages are available on hard-top, convertible or 2+2.

Happy news — and it's all spelled out at your Ford dealer's. Take a reading. Soon!

MUSTANG

Unique Ford GT stripe — badge of America's greatest total performance cars!

DE WALT DISNEY'S MAGIC SKYWAY AT THE FORD
ITOR COMPANY PAVILION, NEW YORK WORLD'S FAIR

Urheberrechtlich geschütztes Material

[Continued from page 80]

four inches lower, and almost 20-percent lighter is under construction in the Paxton shops. Bobby Unser will test both and race the one he likes best. Both have the highly refined Ferguson four-wheel-drive system with a limited-slip differential between front and rear wheels.

When Mickey Thompson was in Italy last year, he met Alessandro de Tomaso and saw the latter's rear-engined racing car. Its chassis is a single large-diameter tube serving both as a backbone frame and a fuel tank. This may have inspired Thompson to design his 1965 Indy car, which has a large titanium tube running the full length of the car on the right. The fuel tanks are inside it, and the seat and the engine are carried by supporting framework. A four-cam Chevy-based engine is placed back-to-front ahead of the driver, with the transmission and final drive between the front wheels. All four wheels have independent suspension.

The Lotus-Ford. Everywhere Team Lotus goes, it goes as a favorite. Its cars are the most advanced in design, with the lightest weight and the lowest frontal area. Many have tried to imitate the inspired Lotus designs of Colin Chapman, but the basic simplicity of his original work has always eluded the copiers. The 1965 Lotus will be generally similar to last year's model, with a Ford engine behind a sharply raked driving seat, and offset suspension. The three-car team will be led by Jimmy Clark.

Cars built by A. J. Watson have won six times at Indy. Last year Watson made his first rear-engine car, and Rodger Ward drove it to second place. Now Watson is about to complete two new Ford-powered rear-engine cars—one for Don Branson and one for Rodger Ward.

1963 winner Parnelli Jones will be driving a new Ford-engined car built by Ed Kuzma, one of a team of three to be raced as Hurst Floor Shift Specials. They will be sponsored by George Hurst Jr. in partnership with J. C. Agajanian. The frame is a unit-body aluminum structure, offset to the left on the suspension arms, with a sharply reclined seat and the engine in the rear.

The two others are for A. J. Foyt and Bud Tingelstad. Foyt's car will be entered by the Ansted-Thompson Racing Division; Tingelstad will drive for Lindsey Hopkins (who last year fielded the sensationally fast Lotus-Ford driven by Bobby Marshman).

Ted Halibrand was a newcomer to Indy last year. Wally Meskowski built a Ford-engined car that Halibrand designed, and Eddie Sachs qualified it at 151.439 m.p.h. No less than six Halibrands, nicknamed Shrikes, are now being built. They will be rear-engine, Ford-powered cars, with magnesium-alloy unit-body frames. Dan Gurney will drive one, Lloyd Ruby will drive another (to be raced as the American Eagle Special), and Ebb Rose has ordered a Shrike which he may drive himself.

Tony Robinson of BRP (British Racing Partnership) is building two cars for George Bryant. The design follows Lotus practice to a large extent, but only the seat is offset, not the whole chassis. The BRP-Fords will be driven by Masten Gregory and Johnny Boyd.

Other Ford-engined entries include a Kuzma-built car for Gordon van Liew, to be driven by Roger McCluskey, and the Precision Ring Special that Jim Hurtubise will pilot.

The Offies. The main Offy opposition will come from Kjell Qvale's racing stable with three Liquid Suspension Specials designed by Joe Huffaker. The drivers will be Jerry Grant, Walt Hansgen, and Bob Veith. The 1965 cars will be similar to last year's, with a chrome-molybdenum steel tube space frame, a rear-mounted Offenhauser, and rubber-and-water-suspension units taken from the MG 1100 sedan.

Other rear-engined Offy-powered cars will be entered by Rolla Vollstedt for Len Sutton, by Federal Engineering for Bob Harkey, and by Fred Gerhardt. Mel Kenyon will drive Federal Engineering's Offy roadster, and Arnold Knepper will drive the Vatis-built Konstant Hot Special roadster. Bob Wente will drive an old Watson-built roadster for G. C. Murphy. But with all the modern racing cars, the roadsters will have a hard time qualifying.

Of course, the new tires will mean higher speeds for roadsters *and* rear-engined cars. During tests with Firestone tires, such drivers as Rodger Ward, Parnelli Jones, and Len Sutton got a foretaste of things to come. They lapped at over 162 m.p.h., and the best four-lap average was 161.98. And Tim MacElreath in the STP-Novi was clocked at 199.30 m.p.h. down the pit straight!—*Jan P. Norbye.* ■ ■

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Wow. Want better luck the next time you paint?

This is the last stage in paint deterioration.

It's time to repaint. But why use a paint that may let *this* happen soon again?

Your house always generates ordinary moisture (appliances, showers, cooking all cause moisture). That moisture tries to get out through your paint job. Ordinary oil-base paints won't *let* it out. You get blistering, then the kind of peeling you see in the picture (and on your house?).

Du Pont Lucite® House Paint lets the moisture out without letting any water penetrate *in* when applied over bare wood. It also dries far faster than oil-base paints, holds its color much longer, goes on without a priming coat (except for spot priming bare places), goes on over damp surfaces (just after a rainstorm, for instance), goes on over wood, masonry, stucco—any surface—and cleans up with just soap and water.

Less work, more wear.

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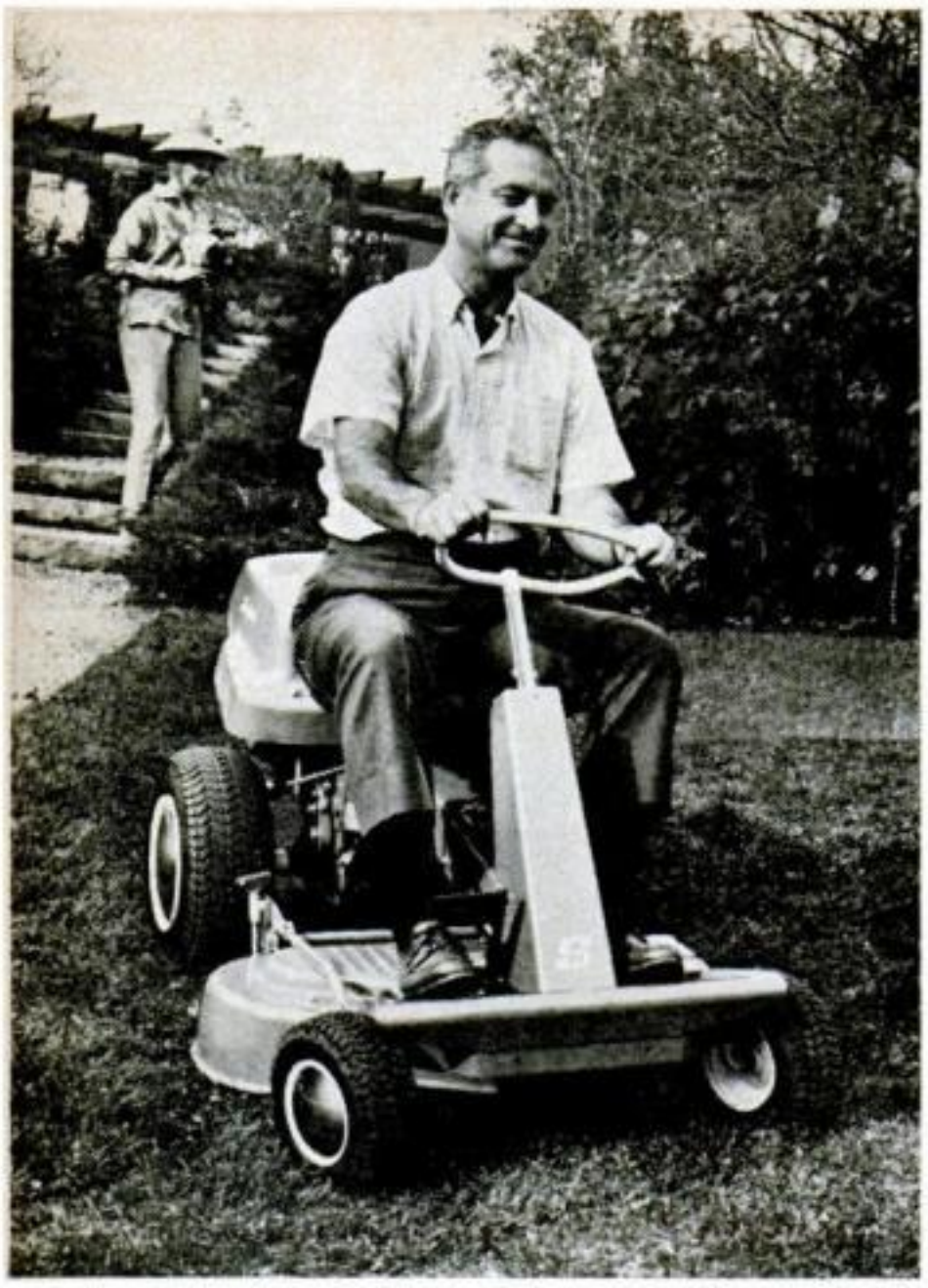

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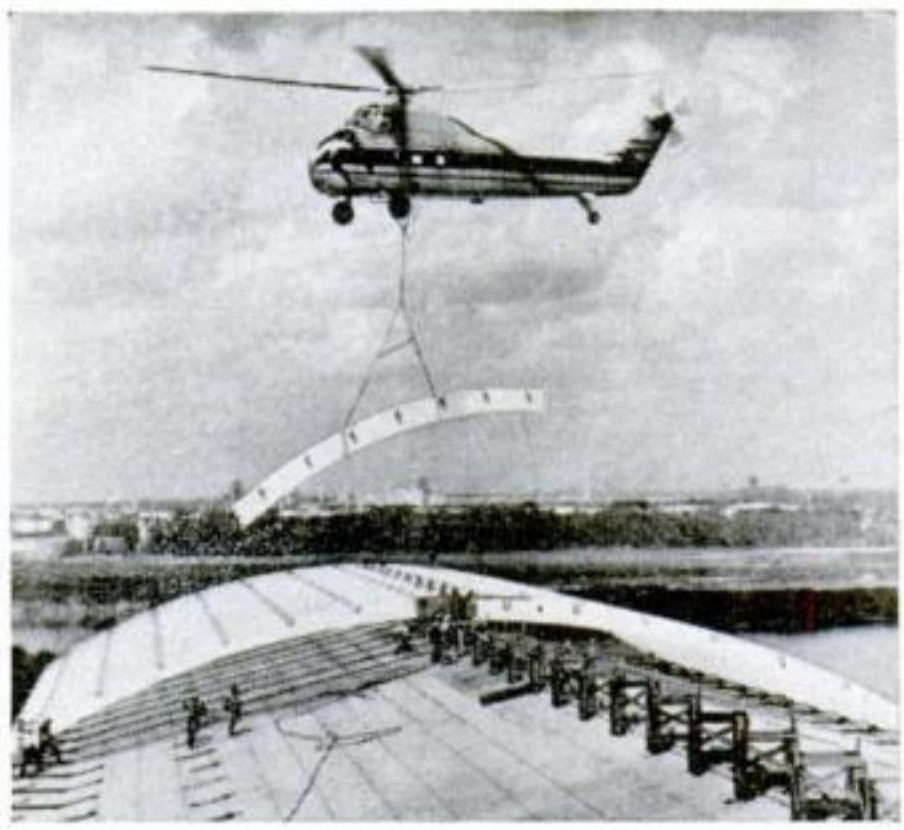
PS PICTURE NEWS

Nipponese overhead traffic tower

The Tokyo metropolitan police direct traffic at a six-way intersection from a tower that provides a view in all directions. The cop on duty (dubbed an astrocop by residents) controls traffic lights for each street, can adjust timing of red and green to relieve congestion.



Skyhook speeds up roof building

A helicopter simplified the hoisting of 3,400-pound wooden beams into position for a 100-foot-high roof on a fertilizer plant being built at Pasadena, Tex. It made 66 trips with one beam a trip, completing in one day a job that would have taken three weeks with derricks on the ground.

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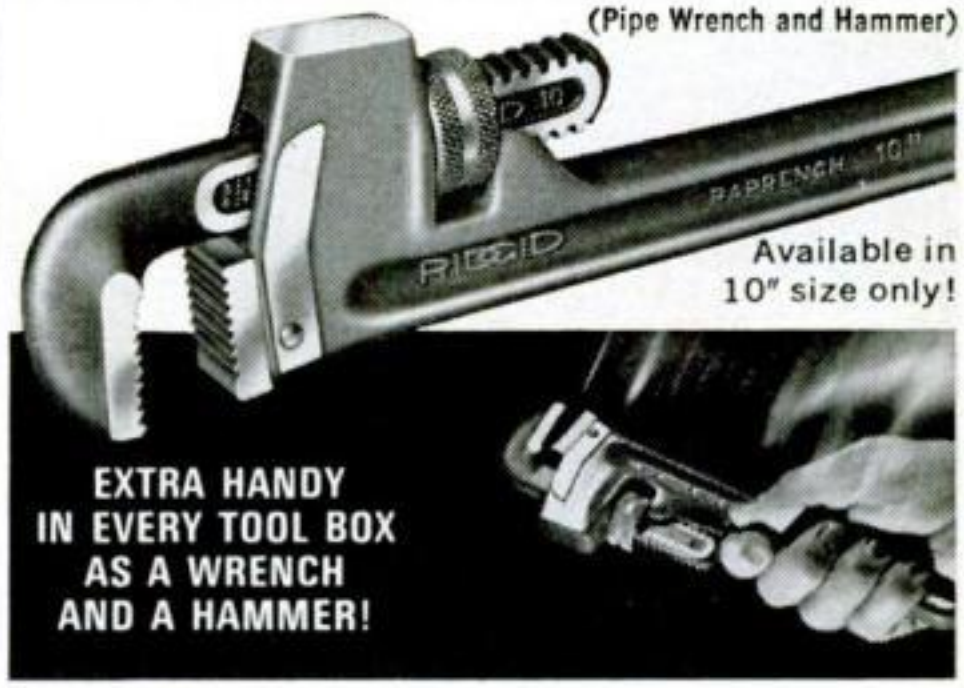

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Wordless Workshop

By Roy Doty

What does "torture testing"

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Torture testing is a must . . . to assure exceptional accuracy and long service life of levels. Stanley levels are tested in extremely hot and cold temperatures and under severe shock conditions. Here are three reasons why Stanley levels can pass these rigid tests: (1) A durable truss-constructed body locks accuracy in. (2) A close-tolerance milling operation makes the top and bottom and both ends perfectly parallel for positive accuracy. (3) Solid-set level vials are protected by shock-padded glass covers.

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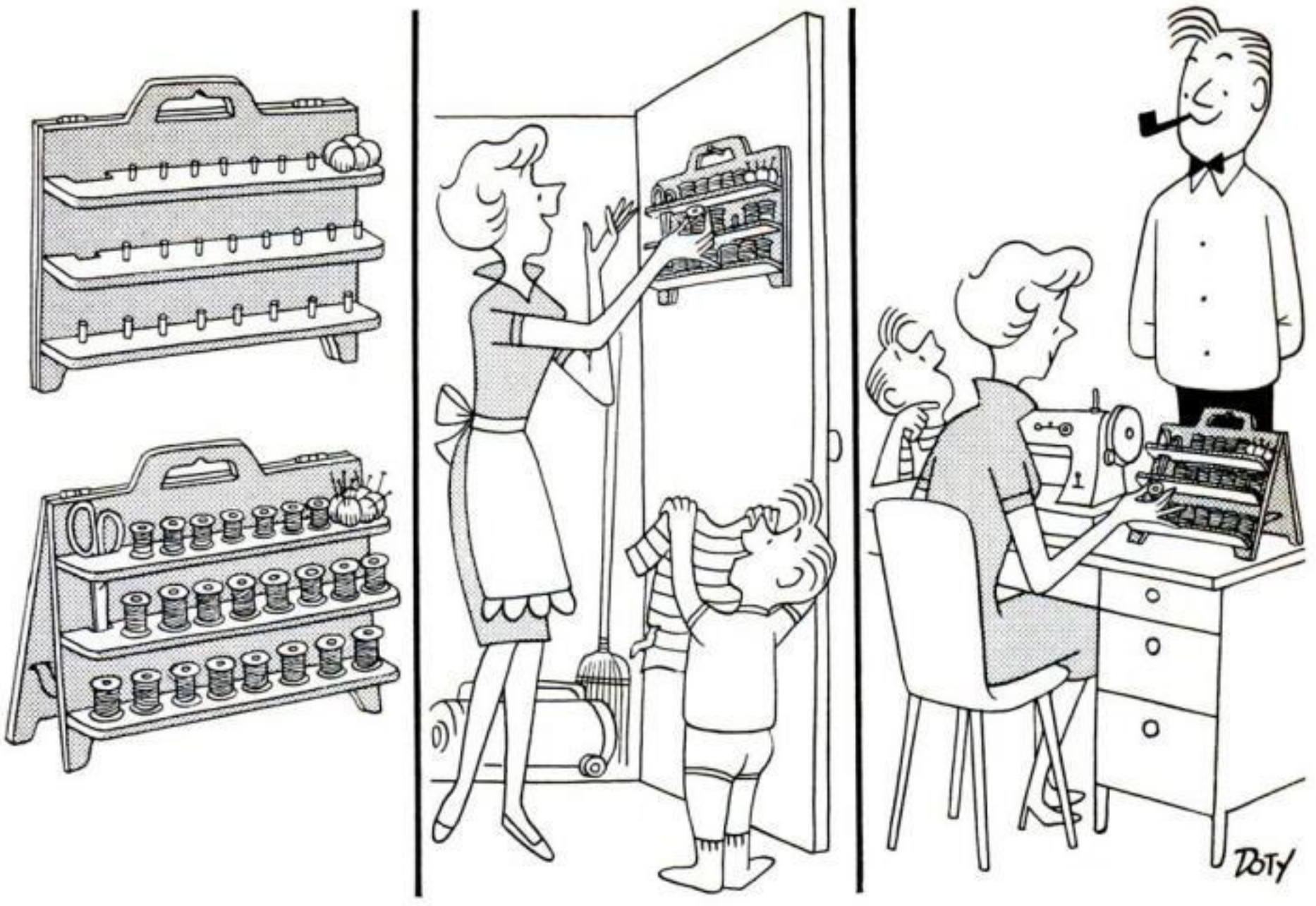

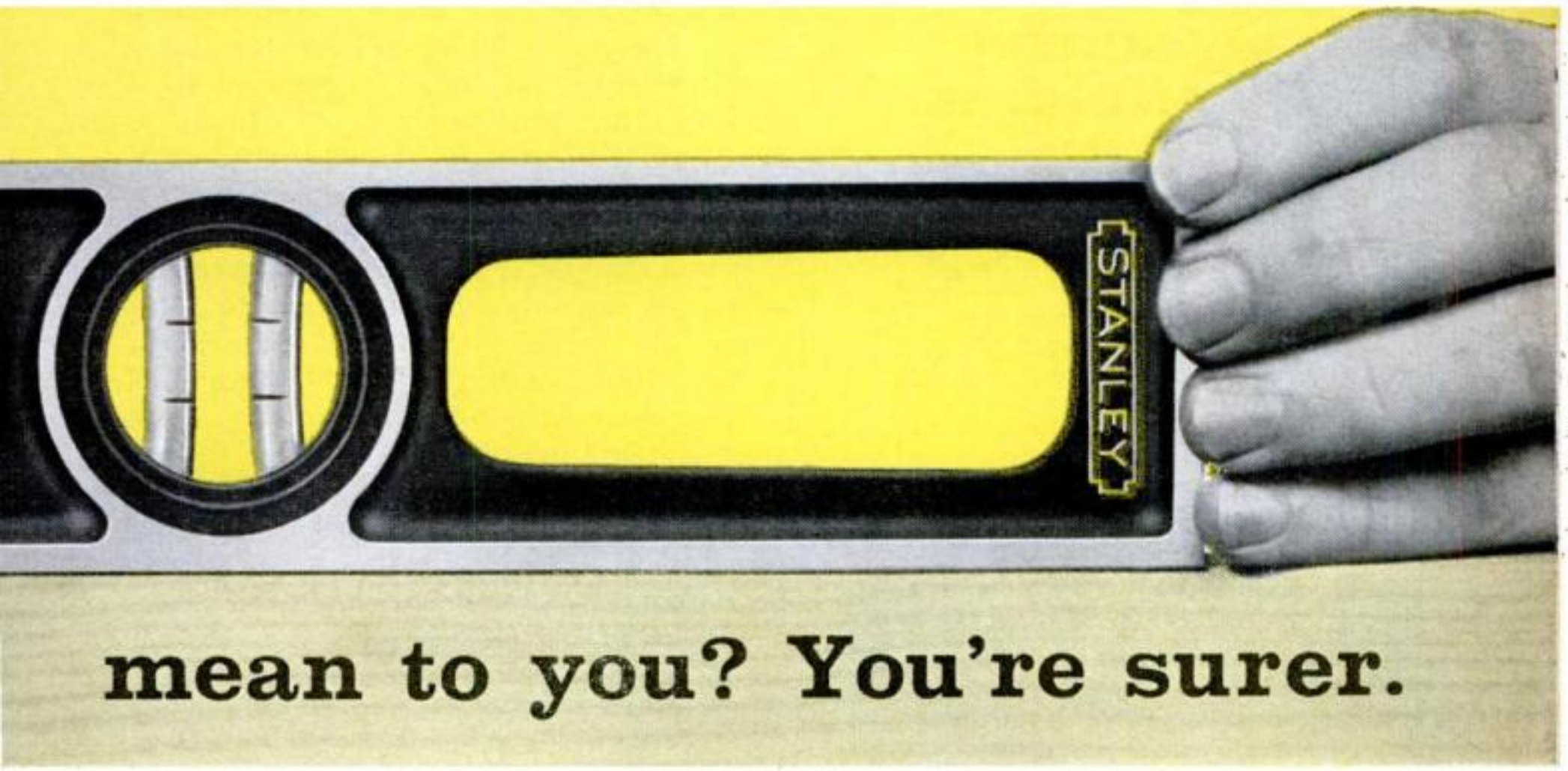

mean to you? You're surer.

Whether you are a hobbyist or a professional, it's comforting to know that Stanley quality levels are accurate to start with . . . built and tested to stay that way. Stanley Tools, Division of The Stanley Works, New Britain, Connecticut. In Canada: Hamilton, Ontario.

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Billy Graham's Physical Fitness Program

[Continued from page 64]

If you sit all day, most of your capillaries have no reason to open. The big muscles they serve become dumb and numb. Their thousands of tiny channels fill with sludge and silt. Add a few stresses such as business difficulties, grief, suffering, quarreling—and your tension may become so habitual that it takes over permanently. We sometimes say that our nerves "tighten up." When this happens, the capillaries cannot open. With much of the circulation system now shut off, the heart automatically works harder to drive blood where it "knows" it is needed. Pumping harder, it drives up the blood pressure, a precursor of trouble.

"The work we give our men just literally forces these blood vessels open," Cureton says. "It's a beautiful thing to see. It begins to happen in low gear, but you can pry them even wider in middle gear."

The pumping mechanism. Few understand the mechanics of moving blood. First the right side of the heart pumps old blood through the lungs, where it soaks up oxygen. The fresh blood is pushed on to the left side of the heart and pumped by way of the arterial tree to the capillaries. Then it trickles into collecting tubes called venules, which are small veins.

Nature has provided a second pump to lift blood back to the heart from below. Veins in the legs are fitted with many tiny valves, and are threaded through muscles. When a leg moves, muscles squeeze the veins and push the blood upward, to a big cistern-like vein in the abdominal cavity.

Now the diaphragm, a domelike roof of muscle over the abdominal cavity, takes over. Each time you breathe, it flattens down hard. Something has to give. The blood in the abdominal cistern is squeezed out and up to the entrance of your thirsty heart—and the cycle is complete.

Billy Graham met Dr. Cureton for the second time last New Year's Eve in Urbana, Ill., where he was to address 7,000 members of the Inter-Varsity Christian Fellowship, students from all over the world. That morning he went through tests at the Physical Fitness Lab, enduring the scrutiny of relentless electronic, mechanical, and psychological testing devices. He looked so much better that Cureton asked, "How often are you working out?"

"Every day. I don't even miss Sunday."

On the treadmill. Cureton and his staff

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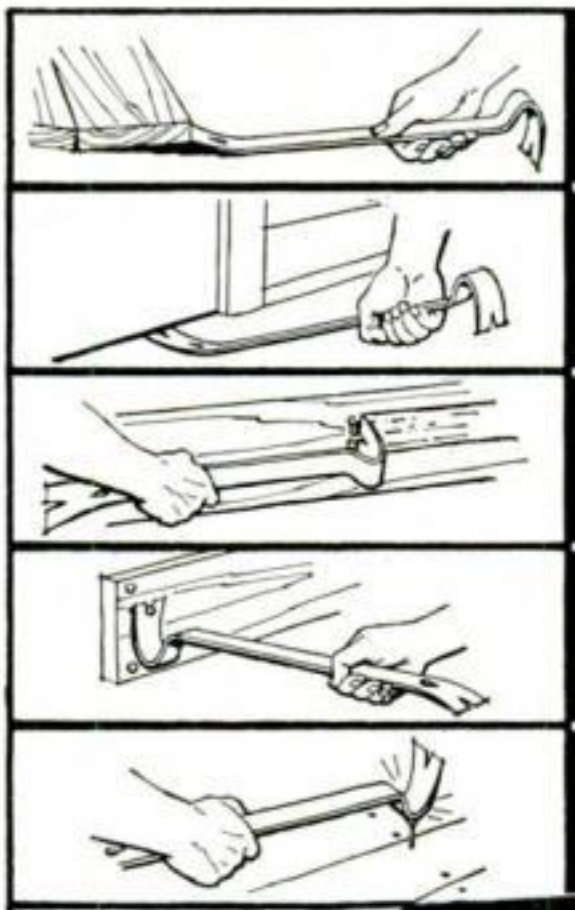
SUPERBAR



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Billy Graham's Physical Fitness Program

supervised the tests, for which more than 100 techniques and instruments were available. A man could run at known speed up a known incline in a treadmill while bags collected his exhaled air; an analysis of this would show how efficiently his "engine" was working. They put Graham on the treadmill for a short run.

Cureton was interested in measurements that would reflect an improvement in circulation. One such test uses a device called a Heartometer. It measures the surge within an artery, the same pulse wave that your family physician notes when he counts your pulse. On the Heartometer, the force of this wave is recorded on a revolving disk by a needle that is actuated when the wave strikes a tight, air-filled cuff on the subject's arm. When the heart is unfit, the ebb and flow of this wave inscribes a low, shapeless triangle. When the heart is fit, the triangle becomes tall, broad, and sharply spiked.

Graham's tracings lay between the two extremes.

They took him next to the cardiovascular lab and its ballistocardiograph. It would check the Heartometer findings and other measurements. When a man lies prostrate, each beat of his heart throws a jet of blood headward into his aorta. When this fast-moving blood hits the aorta's hairpin turn a few inches away, it delivers a blow. As the impact shakes the body, an electric pickup traces a jiggle on paper. A weak heart makes a tiny shake, but a powerful one draws big peaks and valleys.

"How am I doing?" the evangelist asked.

"You're doing fine—but remember that you're still in low gear. The big changes come in middle gear."

Into middle gear. Encouraged, the evangelist went on to his crusade in Hawaii. His body was responding. In Hawaii, reporters found him running on the beaches. "The hardest part of my program," he has told friends, "was getting used to being stared at."

Besides calling for jogging, his middle-gear instructions said he should finish each session with harder calisthenics—working up to eight push-ups and to 20 leg raises with the knees straight, while lying on the back, followed by 20 sit-ups.

If you were following a similar program, and a pool was available, you could swim a fast lap and loaf or walk back. Very grad-

CONTINUED

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MEN PAST 40

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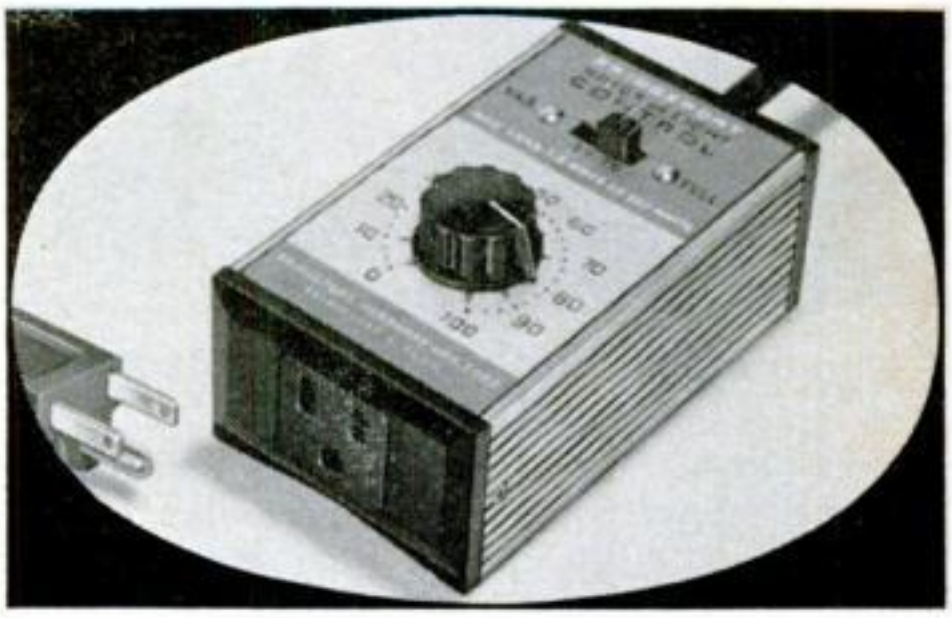

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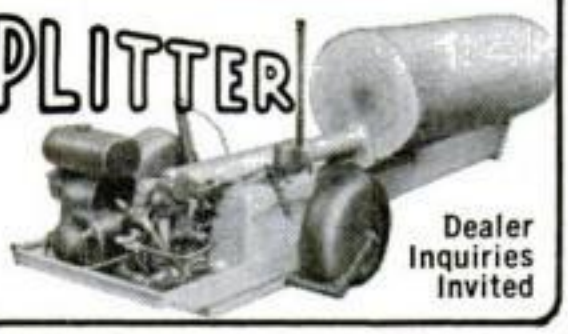

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ually you could build up the hurry-and-loaf routine, to 10 or so times a day, and then reduce the rest periods until you were swimming 10 fast laps without rest.

High gear, if Billy Graham ever undertakes it—or if you do—is an intensification of the same work. You go at it harder or faster, or both.

The general principles. In all three gears, these principles must be observed:

1. Get a good medical examination and your doctor's advice before beginning any exercise program.

2. Warm up first with bending and stretching exercises for about 15 minutes. Make sure every large group of muscles and every joint is alternately stretched and relaxed. In the warm-up, easy does it.

3. Endurance does not come from games but from walking, jumping, jogging, swimming, rowing, skiing, skating, or dancing. The emphasis is on continuous, rhythmic, vigorous movement. To develop endurance, begin at a slow pace, then pick up to a faster one until you are slightly out of breath. Slow down and recover. Repeat this overload-and-rest procedure for 30 minutes. After several months you will want to increase the pace.

4. Work hard enough to perspire.

5. Taper off with easy calisthenics. Lie on your back and bicycle your legs in the air. Breathe deeply. Stretch. Give yourself a hand massage.

6. Take a short hot shower and a long cool one. Each month, make it a little colder. Towel yourself hard.

As you read this, Billy Graham will be preaching—and running, through the early morning of each day, to develop the stamina he needs. "Your body is like a tree," he reminds associates. "When the trunk goes, everything goes."

Saint Paul said much the same thing centuries ago. "Your body is a temple of the Holy Spirit," he wrote. "So glorify God in your body." ■■

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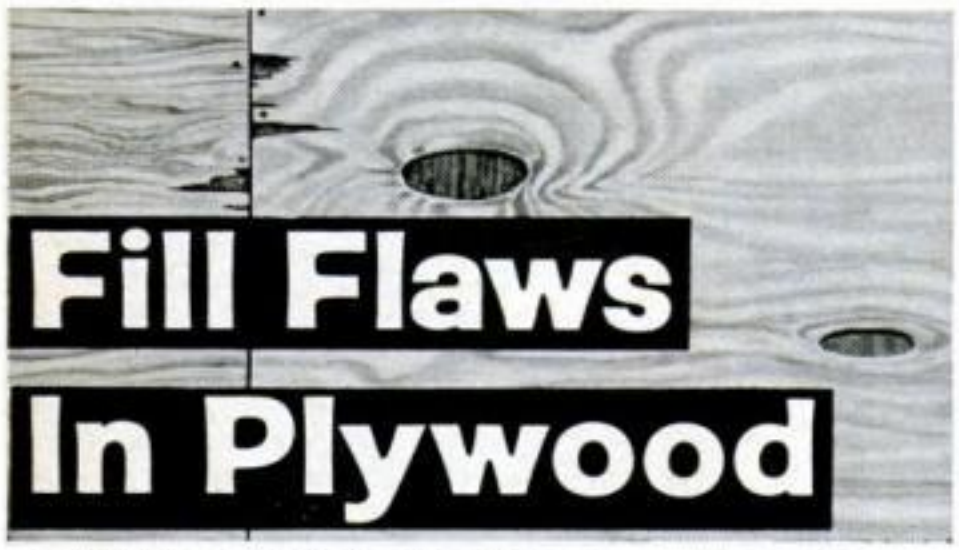

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[*Continued from page 92*]

three. The Plymouth is easily best in this respect, since it has the largest-displacement engine and the lowest fuel economy. The Ford and the Chevy, within five hp. of each other, will accelerate almost side by side up to about 50 m.p.h. before the Ford pulls away—not because of more power or lighter weight, but because of its more versatile transmission. Its advantage in actual traffic, however, is marginal, as neither engine can be called lively. Both have low power reserves for passing or high-speed merging.

I'd recommend larger engines for both these cars (the optional 352-cu.-in. V-8 for Ford and the 327-cu.-in. V-8 for the Chevrolet). The improvement in ease of driving will be well worth the slightly higher first cost. Fuel economy shouldn't be severely affected, because the 289-cu.-in. Ford and the 283-cu.-in. Chevrolet engines have to work very hard in these wagons. A larger engine operating under lighter loads has a theoretical advantage on fuel consumption. The fact that the Plymouth used more gasoline than the two others is more a reflection on its higher curb weight than on the much greater displacement of its engine.

Sensibly, the Plymouth is available only with the 318-cu.-in. V-8, while the GM and Ford products can even be bought with six-cylinder engines—an idea that we would warn against. The base-model V-8s are the smallest engines capable of propelling these cars with relative ease in today's traffic—on the highway or in the city.

Putting on the brakes. The Ford brakes began to fade during acceleration runs that left the two others relatively unaffected in terms of fade. After four stops from 80 m.p.h., the brakes would hardly slow the Ford at all, with any amount of pressure on the pedal. The Plymouth brakes faded after five hard stops from 80 m.p.h., but recovered easily. The Chevrolet brakes only showed signs of impending fade after five similar stops, but the smell of the scorched linings was unmistakable, and the brakes took longer to recover completely than on the Plymouth.

The brake tests were made with unladen cars—we would hate to be on a mountain road with any of these models carrying a heavy load. The retarding effect of the transmissions (when downshifted to In-

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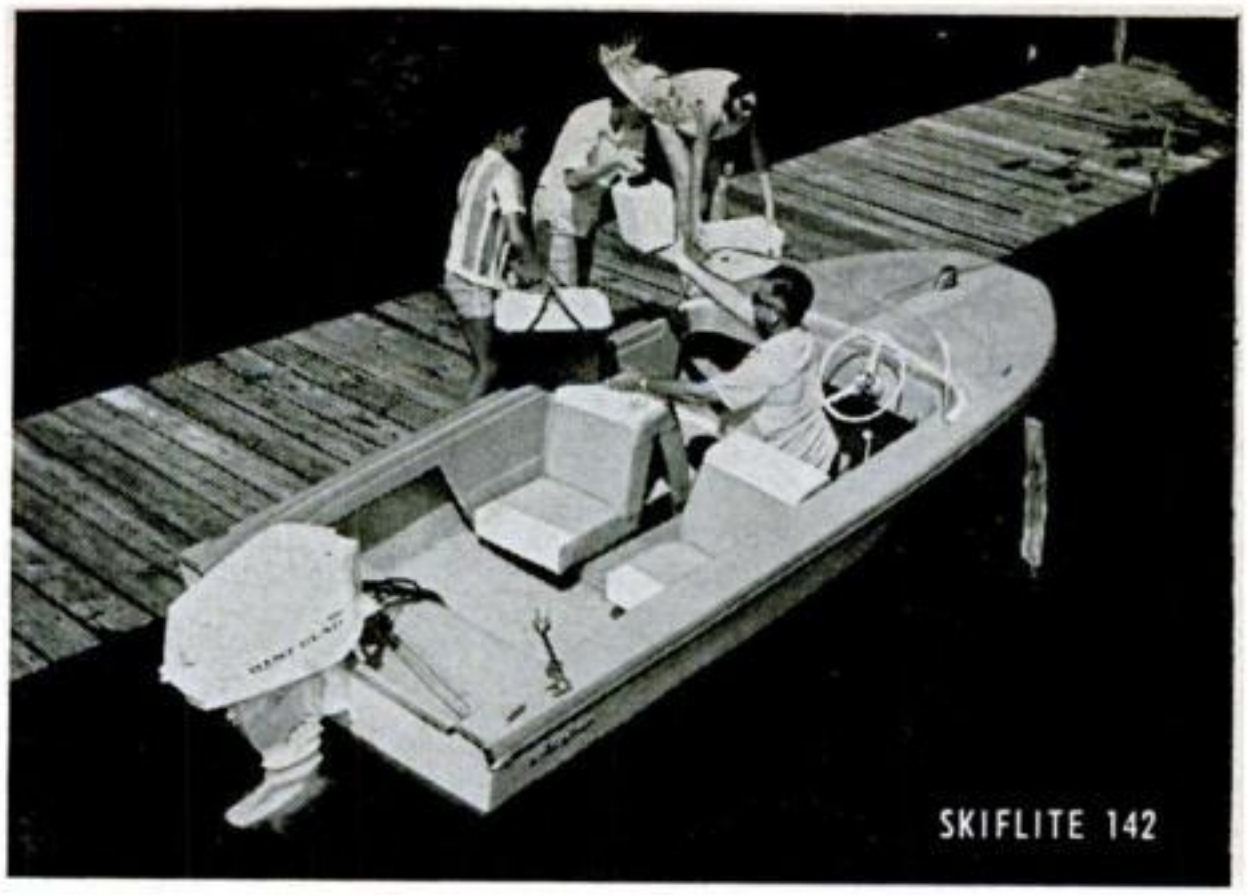

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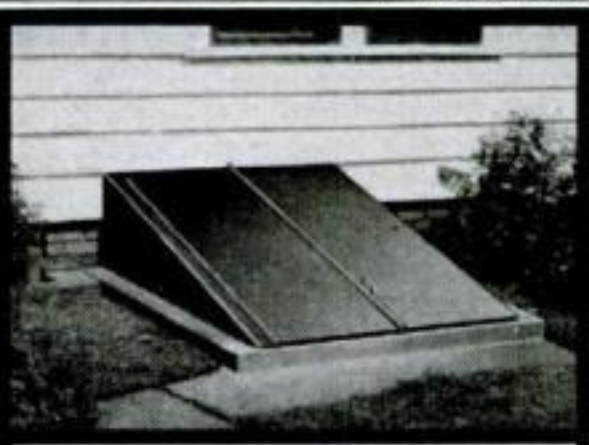

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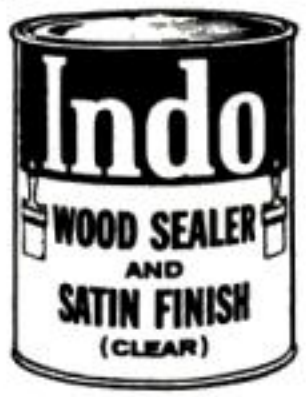

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termediate or Low) will be a help, but on downhill runs with alternating braking and acceleration, the brakes on all three cars proved inferior to the standards set by both the leading drum-brake models and the domestic cars fitted with disk brakes.

None of the power steering systems offer adequate feedback from the road or sufficient caster action, but the Ford steering wheel had a particularly "dead" feel. On fast turns, all responded well. The Plymouth has the fastest response and the least steering-wheel movement for a given turn radius, but the Chevrolet seemed to have the edge on handling precision.

The seating position is most comfortable in the Impala; its steering wheel is placed lower in the lap and the driver does not have to raise his arms to the somewhat tiresome position normally adopted in the Ford and the Plymouth.

The Impala is also the most maneuverable of the three, with a turning-circle diameter two feet tighter than the Ford's, and 3½ feet tighter than the Plymouth's.

How much payload? Station wagons based on passenger-car chassis are designed for about a half-ton payload, including the passengers. We decided to test the overload reserve by compressing the rear springs until they hit the bump stops.

The greatest load went into the Plymouth—a fantastic pile of 20 cement bags of 80 pounds each—1,600 pounds. The Ford and the Chevy each took 17 bags, or 1,360 pounds. Ground clearance was down to 1½ inches (exhaust pipes), but the cars could be driven without any mechanical noises occurring. Naturally, we did not drive the cars on the road with such overloads—the factories run their own spring-fatigue tests and duplication would be pointless.

When testing the Chevrolet, Ford, and Plymouth sedans [PS, Dec. '64], we found the quality of the workmanship to be commendably high, and the same applies to the station wagons. Only on the roughest surfaces could we provoke rattles from the tailgates; the hoods and doors fitted neatly on all cars, and paintwork and finish were of a uniformly high order.

The modern all-steel station wagon has certainly come a long way. They're hardly kin to the wood-paneled delivery truck models that surrounded suburban railroad depots in the dear dead days of the Model A Ford. ■ ■

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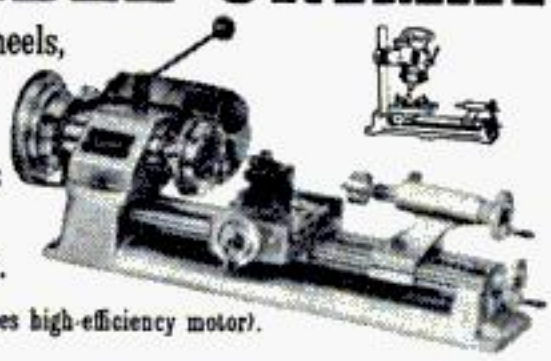

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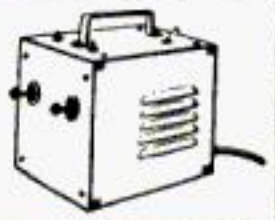

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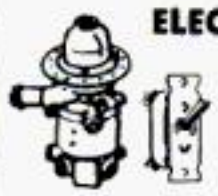

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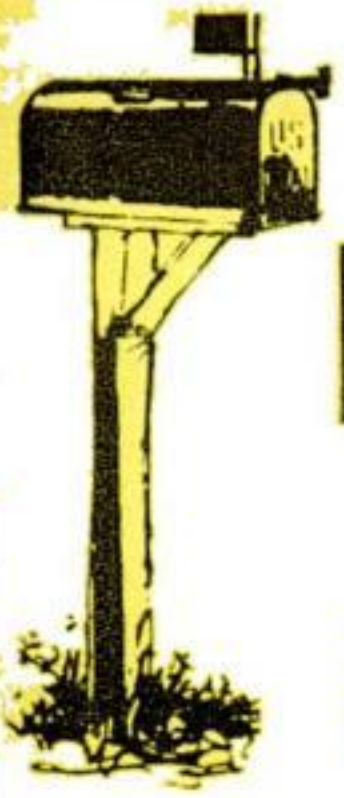

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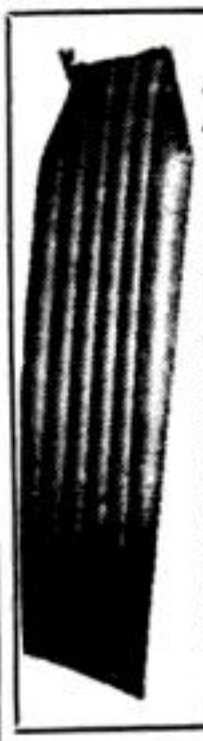

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HOW and Where to Buy Maps of Lost, Buried and Sunken Treasure. $3.00. Franklin, Box 532, Owosso, Michigan. 48867.

SAVE! Build Transistorized Treasure Finder. Details Free. Del Research, Box 347, Alden Manor, Elmont, N.Y.

NEW Coin Locator! Free literature! Howe, 811-A Kansas, Atchison, Kansas.

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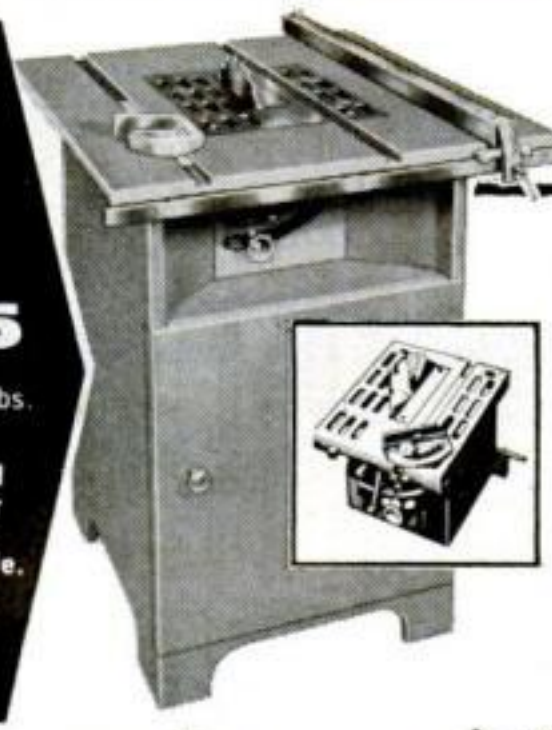
BUY DIRECT FROM OUR FACTORY — Amco POWER TOOLS — SAVE AS MUCH AS 80%

8" TILT ARBOR POWER SAW $14.95

f.o.b. factory. Wt. 25 lbs.

Includes completely assembled cast iron and steel 8" tilt arbor power saw with ground cast iron table . . . . less blade. If desired, RIP FENCE for easier work alignment, $3.50 additional



REVOLUTIONARY PATENTS DECREASE COSTS, INCREASE EFFICIENCY
Full scale power tools of heavy duty 100% cast iron and steel. Streamlined design reduces weight, cuts material and production costs. Special patents provide added efficiency, accuracy, savings. Parts made, assembled, tested and packed right in our own factories, shipped direct . . . save store profits.

DOES WORK OF $75 BENCH SAW
as is. Converts easily to equal any $300 floor model cabinet units! Crosscuts, rips, mitres, cuts compound angles, dadoes, makes coves and mouldings.

FREE CABINET BASE PLANS
Use as portable bench saw as received (inset photo) . . . or transform easily and inexpensively into floor model (as shown) guar. to do work of floor models costing $300. FREE plans . . . sheet of ¾" plywood and 3-4 hours are all you'll need. Use your AMCO saw for cutting. Plans provide 27" x 24" work surface, 33" height, pullout sawdust bin, tool storage compartment.

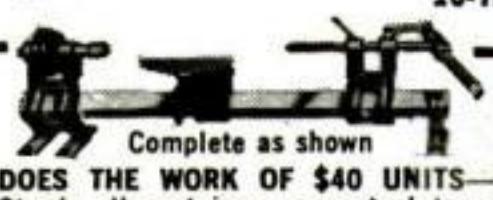
10-YEAR FULL SERVICE GUARANTEE

BLADE TILTS . . . TABLE STAYS LEVEL
• Locks securely at any angle to 50°, raises, lowers 0"-2¼" • Patented tilt mechanism, accurate etched scale • Patented motor mount takes std. ¼ h.p. or larger motor, keeps belt tight, assures perfect alignment at any angle, transmits full power • Takes std. blade, saw insert removes to take dadoe heads, cutters, etc. (not incl.) • Accurate mitre gauge assembly • Ground spindle • Enclosed steel base • "Compo" bearings • Accessories available at factory prices • RIP FENCE, if desired for easier work alignment: Std. size (for bench saw) $3.50; larger fence (for cabinet base, as ill'd.) $4.50.

6" SWING 3-FT. LATHE $9.85

f.o.b. factory

Optional Faceplate for turning bowls, trays, lamp bases, rosettes, etc. $2.50



Complete as shown

DOES THE WORK OF $40 UNITS—
Sturdy all cast iron power tool turns wood or plastics with the precision and speed of machines selling for 4 times as much. Tubular steel bed, ball thrust cup center, spur center. T-Rest assembly, lever action tail stock. 2 speed pulley. Fits any motor.

10-YEAR FULL SERVICE GUARANTEE

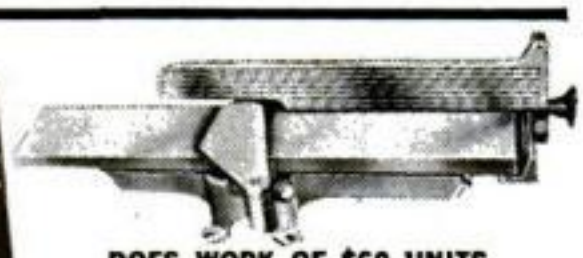
UNCONDITIONAL 10-DAY MONEY BACK GUARANTEE

You must be fully satisfied. If not, return in 10 days, freight collect. Money refunded in full, no questions asked.

FULL 22" LONG, 4⅛" JOINTER-PLANER $19.95

F.O.B. Factory Complete as shown

100% precision ground cast iron and steel.



DOES WORK OF $60 UNITS
Now, at little more than a hand tool price, a guaranteed professional quality precision machine which does same work as skilled hand planing . . . much faster, more accurately. Make accurate glue joints; rabetting cuts for doors, window frames, table drawers; square taper cuts for chair legs; accurate beveling.

• Precision ground cast iron tables, adjustable for depth of cut • Rigid cast iron base • New patent-pending design holds clearance between knives and tables at any depth • Rabett depth ⅜" • Hardened, ground high speed steel knives • Patent-pending fence adjustable to any position, any angle 0°-50° • Patent pending lift-off guard (nothing to loosen!) • Balanced steel cutter head.

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W OR GE 1/2 HP ELECTRIC MOTOR

SPECIAL AMCO PRICE (when purchased with any unit in this ad) $12.95 f.o.b. factory

if purchased separately, $18.95

SPECIAL LIMITED TIME ONLY
Brand new factory-fresh motors for use with any of the units on this page. Limited quantity purchase . . . first come, first served. Wt.: 17 lbs.

FULL SERVICE 1-YEAR WARRANTY
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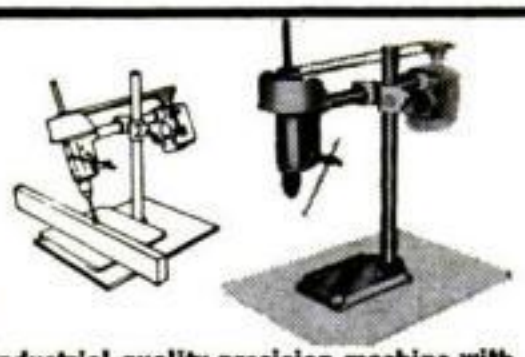
32" RADIAL DRILL PRESS $29.95

F.O.B. Factory

½" Cap. Jacob's Chuck Inc.

Shipping Wt. 30 lbs.

DOES WORK OF $90 UNITS . . . AND A GREAT DEAL MORE



Industrial quality precision machine with all features of standard drill press, many extras. Head raises, lowers. Greatly increased depth of throat. Can be pre-set to any angle or position for on-or-off table drilling . . . even horizontal drilling. All cast iron and steel.

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Please send me the units checked. Payment in full enclosed $..... or $3 deposit each item enclosed, balance C.O.D. ☐ I MUST BE FULLY SATISFIED OR WILL RETURN UNIT WITHIN 10 DAYS FOR FULL REFUND. No questions asked.

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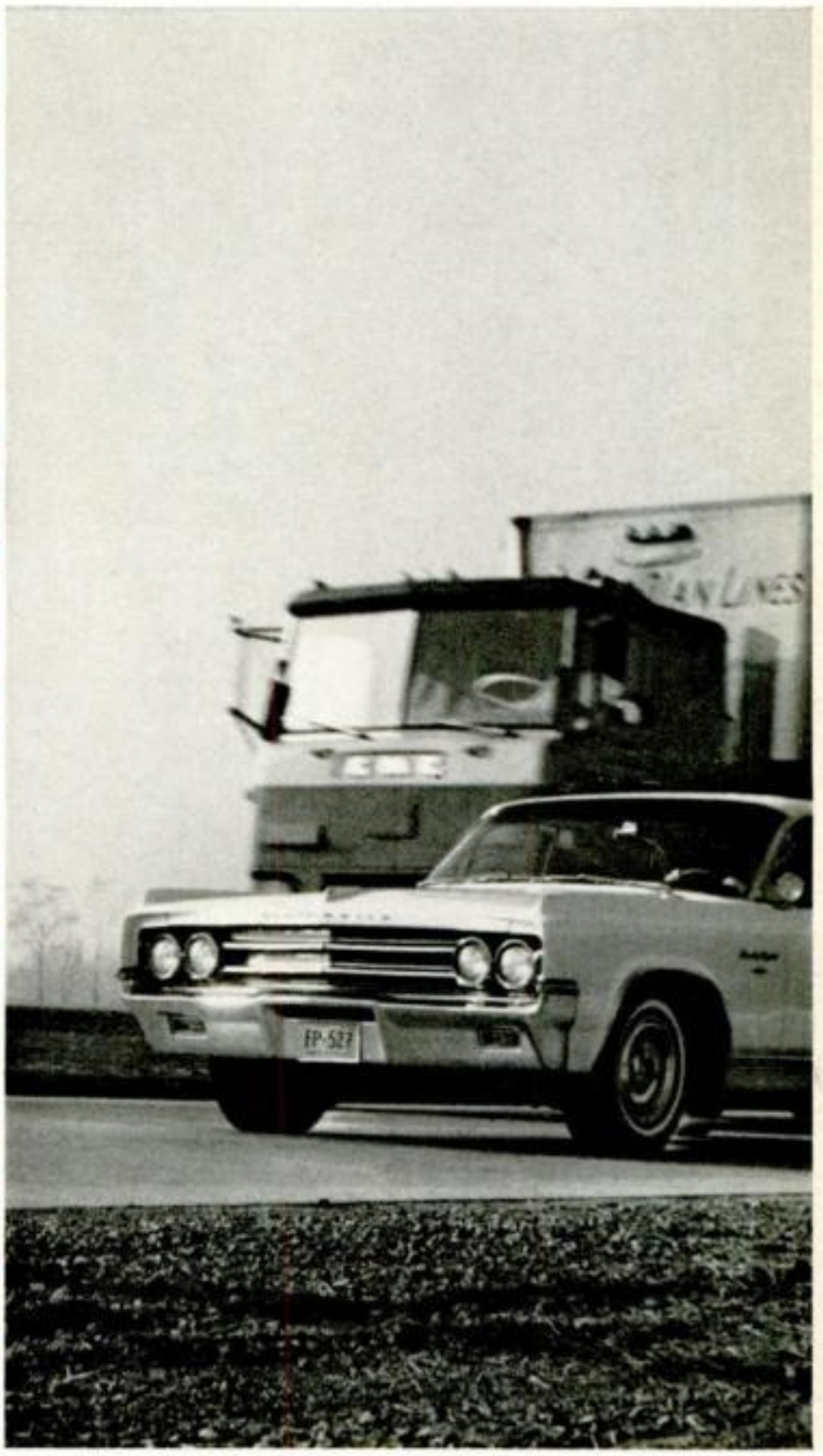
ADDRESS .....
CITY .....ZONE/ZIP .....STATE .....

10-YEAR FULL SERVICE GUARANTEE Any part or parts of any AMCO power tool which may become inoperative for any reason within ten years after the purchase date will be repaired or replaced by the factory without cost to the purchaser. Your only cost: for postage.

Urheberrechtlich geschütztes Material



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Camel's real taste satisfies longer!

The best tobacco makes the best smoke!

Camel smokers know it. The rich, full taste of Camel has never been equaled. There's nothing in the way. No fads. No fancy stuff. Just good taste through and through. Camel has the real taste every smoker wants!

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